Islamic Online University
Lecture Notes for Modules 1 & 2

TEXTBOOK CHAPTER 1: TEACHER AND EDUCATIONAL PSYCHOLOGY

LEARNING OUTCOMES

1 Explain the importance of research in classroom decision making.
2 Draw appropriate conclusions from different types of research studies.
3 Describe several strategies for collecting information about your own students (if you are teaching).
4 Plan long-term strategies for gaining expertise as a teacher.
5 Use effective strategies when you read and study.

Case Study Analysis

The "No D" Policy

What various strategies does Ms. Smith use to foster her students' writing development?

Ms. Smith's initiation of a new grading policy was accompanied by a variety of supporting strategies. She, first, engaged her students by explaining the policy, soliciting their input, and gaining their endorsement. Secondly, Ms. Smith helped students to understand her goals for their learning, discussing and providing concrete examples of A-, B-, and C-quality work. Further, she provided opportunities for students to revise and resubmit assignments, while offering feedback and assistance when needed. Finally, Ms. Smith regularly administered brief surveys to get feedback from her students. These strategies resulted, not only, in better writing results, but also in greater student understanding of the learning goals and process. The student-teacher relationship was also transformed, as students began to understand the role of their teacher as a coach who helps the students to learn and achieve.

Discussion Topics

1. How can teachers use research when making classroom decisions?
2. How might teachers use research findings when communicating with parents?
3. Which topics in education might best be studied with qualitative research? Which might best be studied with quantitative research? With mixed-methods research?
4. In educational research, what are the advantages of having control groups that receive either no intervention or a placebo intervention that is unlikely to have much of an effect? What are the disadvantages? Consider the perspectives of research participants, teachers, and society at large.
5. If we can't control all the possible variables in a study, can we draw any conclusions from it? Is it even possible to control all possible factors in educational research?
6. What ethical concerns or conflicts of interest must you address when conducting research in your own classroom?
7. Given the numerous and complex responsibilities of teachers, how can teachers facilitate their own professional development? What resources might be available to help teachers develop?
8. What study strategies do you use that you would recommend to your classmates?

Teaching as Evidence-Based Practice

You yourself have been a student for many years now, and in the process you've undoubtedly learned a great deal about how children change over time and about how teachers can foster their learning and development. But exactly how much *do* you know? To help you find out, we authors offer a short pretest, Ormrod's Own Psychological Survey (OOPS).

EXPERIENCING FIRSTHAND

ORMROD'S OWN PSYCHOLOGICAL SURVEY (OOPS)

Decide whether each of the following statements is *true* or *false*.

True	False	1. Some children are predominantly left-brain thinkers, whereas others are predominantly right-brain thinkers.
True	False	2. Children's personalities are largely the results of their home environments.
True	False	3. Instruction is most effective when it is tailored to students' individual learning styles.
True	False	4. The best way to learn and remember a new fact is to repeat it over and over.
True	False	5. Students often misjudge how much they know about a topic.
True	False	6. Anxiety sometimes helps students learn and perform more successfully in the classroom.
True	False	7. Playing video games can enhance children's cognitive development and school achievement.
True	False	8. The ways in which teachers assess students' learning influence what and how students actually learn.

Following are the correct answers to each item, along with an explanation regarding *why* it is true or false.

1. *Some children are predominantly left-brain thinkers, whereas others are predominantly right-brain thinkers*. FALSE. With the development of new medical technologies in recent years, researchers have learned a great deal about how the human brain works and which parts of it specialize in which aspects of human thinking. The two halves, or *hemispheres,* of the brain do seem to have somewhat different specialties, but they continually communicate and collaborate in tackling even the simplest of daily tasks. For all intents and purposes, there's no such thing as left-brain or right-brain thinking (Bressler, 2002; M. I. Posner & Rothbart, 2007).
2. *Children's personalities are largely the results of their home environments*. FALSE. Certainly children's home environments mold their behaviors to some extent, but so, too, can teachers and other people outside the family have some influence (e.g., Morelli & Rothbaum, 2007).

   Furthermore, inherited characteristics have a significant impact on children's personalities. From day 1 infants are noticeably different in the extent to which they're calm or fussy, shy or outgoing, fearful or adventurous, and attentive or easily distractible. Such differences in *temperament* appear to have their roots in biology and genetics, and they persist throughout the childhood years and into adulthood (Kagan & Snidman, 2007; Keogh, 2003; Rothbart, 2011).

3. *Instruction is most effective when it is tailored to students' individual learning styles.* FALSE. Contrary to a popular belief, most measures of supposed "learning styles" merely reflect students' self-reported *preferences*, and tailoring instruction to such preferences doesn't noticeably enhance students' learning or academic achievement (Kirschner & van Merriënboer, 2013; Kozhevnikov, Evans, & Kosslyn, 2014; Krätzig & Arbuthnott, 2006; Mayer & Massa, 2003). It is far more important that teachers base their instructional practices on knowledge of the cognitive processes that underlie how virtually *all* students think and learn.
4. *The best way to learn and remember a new fact is to repeat it over and over.* FALSE. Although repeating information several times is better than doing nothing at all, repetition of specific facts is a relatively *in*effective way to learn. Students learn information more easily and remember it longer when they connect it with things they already know. One especially effective strategy is elaboration: using prior knowledge to expand or embellish on a new idea in some way, perhaps by drawing inferences from a historical fact, identifying new examples of a scientific concept, or thinking of situations in which a mathematical procedure might be helpful (J. R. Anderson, 2005; Graesser & Bower, 1990).
5. *Students often misjudge how much they know about a topic.* TRUE. Most adults and children are *not* the best judges of what they do and don't know. For example, many students think that if they've spent a long time studying a textbook chapter, they must know its contents very well. Yet if they've spent most of their time studying ineffectively—perhaps by "reading" while thinking about something else altogether or by mindlessly copying definitions—they may know far less than they think they do (N. J. Stone, 2000; Thiede, Griffin, Wiley, & Redford, 2009).
6. *Anxiety sometimes helps students learn and perform more successfully in the classroom.* TRUE. Many people think that anxiety is always a bad thing. In fact, a *little bit* of anxiety can actually *improve* learning and performance, especially when students perceive a task to be something they can accomplish with reasonable effort. For instance, a small, manageable amount of anxiety can spur students to complete their work carefully and to study for tests (Cassady, 2010b; N. E. Perry, Turner, & Meyer, 2006; Shipman & Shipman, 1985).
7. *Playing video games can enhance children's cognitive development.* TRUE—or more accurately, SOMETIMES TRUE. A great deal of time spent playing video games *instead of* reading, doing homework, and engaging in other school-related activities can definitely interfere with children's long-term academic success. But some video games can be powerful tools for promoting important cognitive abilities, such as sustained attention and spatial reasoning (Gentile, 2011; Rothbart, 2011; Tobias & Fletcher, 2011). And increasingly, educational technologists have been designing highly motivating video games that simulate real-world problems and foster complex problem-solving skills (Barab, Gresalfi, & Ingram-Goble, 2010; Gee, 2010; Squire, 2011).
8. *The ways in which teachers assess students' learning influence what and how students actually learn.* TRUE. We see this principle in action in the opening case study: When Anne Smith's "No D" and multiple-submission policies convey the message that students can't get by with marginal work, students are more likely to seek feedback about their work, benefit from their mistakes, and enhance their writing skills. *Good* assessments encourage cognitive processes essential for high-quality learning. For example, students are more likely to pull class material into an integrated, meaningful whole if they expect assessment activities to require such synthesis, and they're more likely to focus on applying what they learn to new situations if they think that assessments will involve application tasks (Carpenter, 2012; N. Frederiksen, 1984b; Lundeberg & Fox, 1991).

Understanding and Interpreting Research Findings

Many research studies involve quantitative research: They yield numbers that reflect percentages, frequencies, or averages related to certain characteristics or phenomena. For example, a quantitative study might provide information about students' scores on achievement tests, students' responses to rating-scale questionnaires, or school district records of students' attendance and dropout rates.

Other studies involve qualitative research: They yield nonnumerical data—perhaps in the form of verbal reports, written documents, pictures, videos, or maps—that capture many aspects of a complex situation. For example, a qualitative study might involve one-on-one interviews in which students describe their hopes for the future, a detailed case study of interpersonal relationships within a tight-knit clique of adolescent girls, or in-depth observations of several teachers who create distinctly different psychological atmospheres in their classrooms.

To a considerable degree, the research study described at the beginning of the chapter is a quantitative one: Anne Smith tabulates students' responses to various survey questions and computes the percentages of various final class grades. But when she collects the completed surveys, she also looks closely at students' specific comments and suggestions—qualitative information.

Not all research on learning and instruction is *good* research, of course. Furthermore, people sometimes draw inappropriate conclusions from even the best of research studies. It's important, therefore, that teachers understand what various kinds of research studies can and cannot tell us about learning and instruction.

QUANTITATIVE RESEARCH

Quantitative research studies vary widely in nature, but you might think of them as falling into four general categories: descriptive, correlational, experimental, and quasi-experimental. These categories yield different kinds of information and warrant different kinds of conclusions.

DESCRIPTIVE STUDIES

A descriptive study does exactly what its name implies: It *describes* a situation. Descriptive studies might give us information about the characteristics of students, teachers, or schools. They might also provide information about how often certain events or behaviors occur. In general, descriptive studies enable us to draw conclusions about the way things are—the current state of affairs.

CORRELATIONAL STUDIES

A correlational study explores possible associations among two or more variables. For instance, it might tell us how closely various human characteristics are associated with one another, or it might give us information about the consistency with which certain human behaviors occur in conjunction with certain environmental conditions. In general, correlational studies enable us to draw conclusions about correlation: the extent to which two characteristics or phenomena tend to be found together or to change together. Two variables are correlated when one tends to increase as the other increases (a *positive correlation*) or when one tends to *de*crease as the other increases (a *negative correlation*). Correlations are often described numerically with a statistic known as a *correlation coefficient*.

Sometimes correlational studies involve comparing two or more groups that differ with respect to a particular characteristic, such as age, gender, or background.[1] For example, a correlational study might compare the average achievement test scores of boys and girls, or it might investigate whether young children who have had considerable exposure to reading materials at home learn to read more quickly at school than children without such exposure.

Any correlation between two variables allows us to make *predictions* about one variable when we know the status of the other. For example, if we find that, on average, 15-year-olds are more capable of abstract thought than 10-year-olds—in other words, if age and abstract thinking ability are correlated—we can predict that high school students will benefit more from an abstract discussion of democratic government than fourth graders will. And if we find that children learn to read more easily if they've had many previous experiences with books at home, we might take proactive steps to enhance the early literacy skills of children without such experiences. Yet our predictions will be imprecise ones at best, with exceptions to the general rule. For example, even if, *on average,* 15-year-olds have considerable ability to think about abstract ideas, some 15-year-olds will often struggle with abstract subject matter.

A more significant limitation of correlational studies is that although they may demonstrate that a relationship exists, they never tell us for certain *why* it exists. They don't tell us what specific factors—previous experiences, personality, motivation, or perhaps other things we haven't thought of—are the cause of the association we see. In other words, *correlation does not necessarily indicate causation.*

EXPERIMENTAL AND QUASI-EXPERIMENTAL STUDIES

Descriptive and correlational studies describe things as they exist or have previously existed naturally in the environment. In contrast, an **experimental study**, or **experiment**, is a study in which the researcher intentionally changes, or *manipulates,* one or more aspects of the environment (often called *independent variables*) and then measures the effects of such changes on something else. In educational research the "something else" being affected (a *dependent variable*) is typically some aspect of student behavior—perhaps end-of-semester grades, persistence in trying to solve difficult math problems, or ability to interact appropriately with peers. In a good experiment, a researcher *separates and controls variables,* testing the possible effects of one independent variable while holding all other potentially influential variables constant.

Some experimental studies involve simultaneously giving a single group of individuals two or more distinct treatments and comparing the specific effects of each treatment. Other experimental studies involve two or more groups that are treated differently. The following three examples illustrate the multiple-group approach:

- A researcher uses two different instructional methods to teach reading comprehension skills to two different groups of students. (Instructional method is the independent variable.) The researcher then assesses students' reading ability (the dependent variable) and compares the average reading-ability scores of the two groups.
- A researcher gives three different groups of students varying amounts of practice with woodworking skills. (Amount of practice is the independent variable.) The researcher

[1]Such group-comparison studies are sometimes called *causal-comparative studies*. However, as B. Johnson (2001) has pointed out, this label may mislead us to believe that such studies reveal cause-and-effect relationships, when in fact they do not.

subsequently scores the quality of each student's woodworking project (the dependent variable) and compares the average scores of the three groups.

- A researcher gives one group of students an intensive instructional program designed to improve their study skills. The researcher gives another group either no instruction or, better still, instruction in subject matter unrelated to study skills. (Presence or absence of instruction in study skills is the independent variable.) The researcher later (a) assesses the quality of students' study skills and (b) obtains their grade point averages—thus, there are two dependent variables—to see whether the program had an effect.

Each of these examples includes one or more **treatment groups** that are recipients of a planned intervention. The third example also includes a **control group** that receives either no intervention or a *placebo* intervention that's unlikely to affect the dependent variable(s) in question. In many experimental studies, participants are assigned to groups *randomly*—for instance, by drawing names out of a hat. Such random assignment is apt to yield groups that are, on average, roughly equivalent on other variables (e.g., pre-existing ability levels, personality characteristics, motivation) that might affect the dependent variable(s).

Random assignment to groups isn't always possible or practical, however, especially in research studies conducted in actual schools and classrooms. For example, when studying the potential benefits of a new teaching technique or therapeutic intervention, a researcher may not be able to completely control which students receive the experimental treatment and which do not, *or* a particular treatment or intervention may have important benefits for *all* students. In such situations, researchers often conduct a **quasi-experimental study**, in which they take into account but don't completely control other influential factors. Following are two examples:

- A researcher implements a new after-school homework program at one high school and identifies a comparable high school without such a program to serve as a control group. The researcher obtains achievement test data for students at both schools both before and after the program's implementation. Ideally, to document the homework program's effectiveness, the average test scores for the two high schools should be the same *before* program begins but different *after* its implementation. (Such an approach is known as a *pretest–posttest study.*)
- Three researchers want to study the effects of safety instructions on children's behaviors on the playground. The researchers present the instructional intervention to first graders one week, second graders the following week, and kindergartners and third graders the week after that. The researchers monitor students' playground behavior before, during, and after the intervention to determine whether each grade-level group's risky playground behavior decreases immediately following the intervention. (Such an approach is known as a *multiple-baselines study;* study described here was conducted by Heck, Collins, & Peterson, 2001.)

QUALITATIVE RESEARCH

Rather than address questions related to quantity—questions regarding *how much*, *how many*, or *how often*—researchers sometimes want to look in depth at the nature of certain characteristics or behaviors. Imagine, for example, that a researcher wants to find out what kinds of study strategies high-achieving students tend to use. One approach would be simply to ask the students questions such as "What things do you do to help you remember what you read in your

COMPARE/CONTRAST

TABLE 1.1 • Contrasting Various Types of Research

	QUANTITATIVE RESEARCH STUDIES			
	DESCRIPTIVE STUDIES	**CORRELATIONAL STUDIES**	**EXPERIMENTAL AND QUASI-EXPERIMENTAL STUDIES**	**QUALITATIVE RESEARCH STUDIES (DESCRIPTIVE)**
General Nature and Purposes	• Capture the current state of affairs regarding a real-world issue or problem	• Identify associations among characteristics, behaviors, and/or environmental conditions • Enable predictions about one variable, given knowledge of the degree or quantity of another variable • Provide an alternative when experimental manipulations are unethical or impossible	• Manipulate one (independent) variable in order to observe its possible effect on another (dependent) variable • Eliminate other plausible explanations for observed outcomes (especially in carefully controlled experimental studies) • Enable conclusions about cause-and-effect relationships	• Portray the complex, multifaceted nature of human behavior, especially in real-world social settings
Limitations	• Don't enable either (a) predictions about one variable based on another variable or (b) conclusions about cause-and-effect relationships	• Enable only imprecise predictions, with many exceptions to the general relationships observed • Don't enable conclusions about cause-and-effect relationships	• May not completely eliminate alternative explanations for observed outcomes (especially true for quasi-experimental studies) • In some cases, involve artificial laboratory conditions that don't resemble real-life learning environments (true for many tightly controlled experimental studies)	• Don't enable either predictions or conclusions about cause-and-effect relationships
Examples of Questions That Might Be Addressed	• How pervasive are gender stereotypes in popular children's literature? • What kinds of aggressive behaviors occur in schools, and with what frequencies? • How well have students performed on a recent national achievement test?	• Are better readers also better spellers? • Are students more likely to be aggressive at school if they often see violence at home or in their neighborhoods? • To what extent are students' class grades correlated with their scores on achievement tests?	• Which of two reading programs produces greater gains in reading comprehension? • Which method is most effective in reducing aggressive behavior—reinforcing appropriate behavior, punishing aggressive behavior, or a combination of both? • Do different kinds of tests (e.g., multiple-choice vs. essay tests) encourage students to study in different ways?	• What things do high-achieving students say they do "in their heads" when they read and study their textbooks? • What distinct qualities characterize high schools in which members of various adolescent gangs interact congenially and respectfully? • In what ways do teachers' instructional practices change when their jobs and salaries depend on their students' scores on statewide or national achievement tests?

textbooks?" and "How do you prepare for tests in your classes?" Students' responses to such open-ended questions are apt to go in many different directions, sometimes focusing on various behaviors (e.g., taking notes, working on practice problems) and at other times focusing on various mental processes (e.g., trying to make sense of a passage, generating new examples of concepts). Although it might be possible to categorize students' responses and count those falling into each category (thereby obtaining some quantitative data), the researcher may also want to preserve the multifaceted qualities of students' responses by reporting word-for-word excerpts from the interviews.

Qualitative research is often used to explore the complex nature of human behavior in social settings—perhaps in particular social groups, classrooms, schools, or cultures. For example, in-depth qualitative studies have contributed in important ways to our knowledge of school characteristics that affect the academic and social success of students from diverse backgrounds (e.g., Hemmings, 2004; Ladson-Billings, 1995b; Ogbu, 2003).

Like descriptive quantitative studies, qualitative studies *describe* the current state of affairs; they're inappropriate for drawing hard-and-fast conclusions about correlation or cause–and–effect. The rightmost column of Table 1.1 presents examples of questions that might best be answered by qualitative research.

MIXED-METHODS RESEARCH

You shouldn't think of quantitative and qualitative research as an either–or situation. Like Anne Smith in the opening case study, many educational researchers can best address their research questions by combining elements of both quantitative and qualitative research in what is known as a mixed-methods study. For example, in a study described in the *American Educational Research Journal* in 1999, researchers Melissa Roderick and Eric Camburn tracked more than 27,000 students' academic progress as they made the transition from small elementary or middle schools to much larger high schools in the Chicago public school system. Many students showed a sharp decline in academic achievement in ninth grade, their first year of high school. More than 40% of first-semester ninth graders (males especially) failed at least one course, and students who achieved at low levels early in their high school careers were more likely to drop out before graduation.

Such troubling findings are examples of quantitative data, but the researchers also obtained qualitative information that can help us understand the numbers. For instance, they described a student named Anna, who had done well in her neighborhood K–8 school and seemingly had the basic skills she needed to successfully tackle a high school curriculum. Unfortunately, Anna was overwhelmed by the new demands that her ninth-grade classes placed on her, and her first-semester final grades included several Ds and an F. In an interview with one of the researchers, she gave the following explanation:

> In geography, "he said the reason why I got a lower grade is 'cause I missed one assignment and I had to do a report, and I forgot that one." In English, "I got a C . . . 'cause we were supposed to keep a journal, and I keep on forgetting it 'cause I don't have a locker. Well I do, but my locker partner she lets her cousins use it, and I lost my two books there. . . . I would forget to buy a notebook, and then I would have them on separate pieces of paper, and I would lose them." And, in biology, "the reason I failed was because I lost my folder . . . it had everything I needed, and I had to do it again, and, by the time I had to turn in the new folder, I did, but he said it was too late. . . ." (Roderick & Camburn, 1999, p. 305)

INTERPRETING RESEARCH RESULTS: A CAUTIONARY NOTE

Whenever we look at the results of a research study, we can determine that a particular condition or intervention has led to a particular outcome—that is, there is a cause-and-effect relationship between the two—only if we've eliminated all other possible explanations for the results we've observed. As an example, imagine that Hometown School District wants to find out which of two reading programs, *Reading Is Great* (RIG) or *Reading and You* (RAY), leads to better reading in third grade. The district asks each of its third-grade teachers to choose one of these two reading programs and use it throughout the school year. The district then compares the end-of-year achievement test scores of students in the RIG and RAY classrooms and finds that RIG students have substantially higher reading comprehension scores than RAY students. We might quickly jump to the conclusion that RIG promotes better reading comprehension than RAY—in other words, that a cause-and-effect relationship exists between the instructional method and reading comprehension. But is this really so?

Not necessarily. The fact is, the school district hasn't eliminated all other possible explanations for the difference in students' reading comprehension scores. Remember, the third-grade teachers personally *chose* the instructional program they used. Were the teachers who chose RIG different in some way from those who chose RAY? For instance, were RIG teachers more open-minded and enthusiastic about using innovative methods, did they have higher expectations for their students, or did they devote more class time to reading? Or, perhaps, did the RIG teachers have students who were, on average, better readers to begin with? If the RIG and RAY classrooms were different from each other in any of these ways—or perhaps different in some other way we haven't thought of—then the district hasn't eliminated alternative explanations for why the RIG students have outperformed the RAY students. A better way to study the causal influence of a reading program on reading comprehension would be to *randomly assign* third-grade classes to the RIG and RAY programs, thereby making the two groups similar (on average) in terms of student abilities and teacher characteristics.

Whenever you read descriptions of research findings—whether they be in professional journals, in popular print media, on television, or on Internet websites—be careful that you don't jump too quickly to conclusions about what factors are affecting students' learning, development, and behavior in particular situations. Scrutinize the reports carefully, always with these questions in mind: *Have the researchers separated and controlled variables that might have an influence on the outcome? Have they ruled out other possible explanations for their results?* Only when the answers to these questions are undeniably *yes* and *yes* should you draw a conclusion about a cause-and-effect relationship.

FROM RESEARCH TO PRACTICE: THE IMPORTANCE OF PRINCIPLES AND THEORIES

Consistent patterns in research findings have led psychologists to make many generalizations about students' learning and development, along with many generalizations about classroom strategies that can effectively enhance students' academic achievement and personal and social well-being. Some of these generalizations take the form of **principles**, which identify certain factors that affect learning or development and describe the specific effects these factors have. For example, consider this principle:

> A behavior that is followed by a satisfying state of affairs—a reward—is more likely to occur again than a behavior not followed by a reward.

In this principle, a particular factor (a rewarding consequence) is identified as having a particular effect (an increase in the behavior's frequency). The principle can be observed in many situations; following are two examples:

- A student's interpersonal skills improve after we begin praising the student for interacting with peers respectfully and cooperatively. (Here the reward is *praise*.)

- A student becomes more diligent in completing math assignments once we've begun to tailor assignments to the student's current ability level, such that the student more often achieves success in the assignments. (Here the reward is a *success experience.*)

Principles are most useful when they can be applied to many different situations. The "reward" principle—many psychologists instead use the term *reinforcement*—is an example of such broad applicability: It holds true for many different types of learning and a wide variety of pleasant consequences.

Whereas principles tell us *what* factors are important for human learning and development, theories tell us *why* certain factors might be important. More specifically, theories provide possible explanations about the underlying mechanisms involved in learning or development. By giving us ideas about why we are consistently observing certain cause-and-effect relationships, theories can ultimately help us create learning environments that facilitate students' learning, development, and achievement to the greatest extent possible.

Let's consider an example. One prominent theory of how people learn—information processing theory—proposes that attention is an essential ingredient in the learning process. More specifically, if a learner pays attention to new information, the information moves from one component of the human memory system (the sensory register) to another, longer-lasting component (working memory). If the learner *doesn't* pay attention, the information quickly disappears from the memory system; in the words of a common expression, the information "goes in one ear and out the other." The importance of attention in information processing theory suggests that strategies that capture and maintain students' attention—perhaps assigning interesting reading materials or presenting intriguing real-world problems—are apt to enhance students' learning and achievement. It also alerts us to the fact that a concrete reward for learning something new might be detrimental (rather than helpful) if it subsequently *distracts* a student's attention from a learning activity.

You might think of principles as reflecting relatively enduring conclusions about cause-and-effect relationships related to people's learning and development. Principles tend to be fairly stable over time: Researchers observe many of the same factors having an influence over and over again. In contrast, psychological theories are rarely, if ever, set in stone. Instead, they're continually expanded and modified as additional data come to light, and in some cases one theory may be abandoned in favor of another that better explains a particular phenomenon. Furthermore, different theories focus on different aspects of human functioning, and psychologists haven't yet pulled them together into a single mega-theory that adequately accounts for all the diverse phenomena and experiences that comprise human existence.

ASSESSING STUDENTS' ACHIEVEMENTS AND INTERPRETING THEIR CLASSROOM BEHAVIORS

Most teachers regularly assess what their students know and can do, perhaps by examining students' performance in assignments, projects, oral or technology-based presentations, and quizzes. But effective teachers don't limit themselves only to such formal, planned evaluations. They continually observe their students in a variety of contexts—not only in the classroom but also in the hallways and cafeteria, on the playground, during parent–teacher conferences, and so on—for clues about what students might be thinking, believing, feeling, and learning. Students' comments, questions, body language, work habits, and interactions with friends and classmates can provide valuable insights into their learning, development, and motivation.

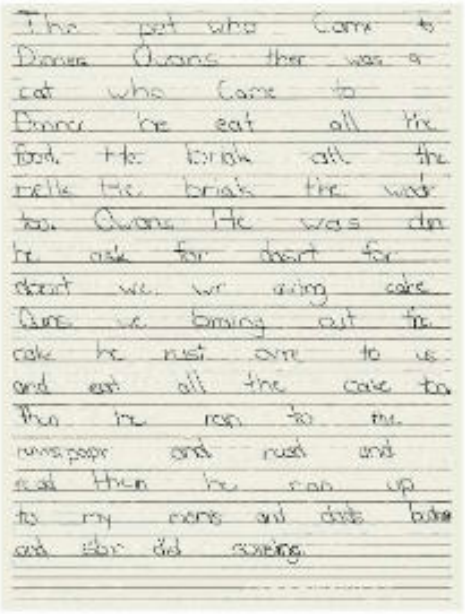
Use assessment results to form hypotheses—but *not* to draw hard-and-fast conclusions—about students' current characteristics and abilities and about effective instructional strategies.

To get your feet wet in the process of assessment, read 7-year-old Justin's short story "The Pet Who Came to Dinner," presented in Figure 1.1. As you read it, consider what you might conclude about Justin's progress in writing. Consider, too, what inferences you might make about Justin's family and home life.

As you can see, Justin has learned how to spell some words (e.g., *dinner, came*) but not others (e.g., he spells *once* as "owans" and *started* as "stor did"). Overall, he knows which alphabet letters represent which sounds in speech, but he sometimes reverses the letter *d* so that it looks like a *b*, and he occasionally leaves out sounds in his word spellings (e.g., his spelling of *drink* begins with *b* and omits the *n* sound). Justin has made some progress in common spelling patterns (e.g., the *-ing* suffix for verbs) and in the use of periods and apostrophes. He has learned to tell a simple story, but he does so merely by listing a series of seemingly unrelated events, and he hasn't yet learned that the title of a story should appear on a line by itself, centered at the top of the page.

Justin's story offers a few hints about home life as well. For instance, it appears that Justin lives with two parents, and he talks about the pet reading the newspaper ("nuwspapr"), suggesting that reading is a familiar activity at home. Are such inferences about Justin accurate? Not necessarily. The conclusions we reach about our students are—like the theories that researchers formulate about learning and development—only reasonable guesses based on the evidence at hand. We must think of such conclusions as tentative *hypotheses* to be tested further, rather than as indisputable *facts*.

FIGURE 1.1 Seven-year-old Justin's story "The Pet Who Came to Dinner."



CONDUCTING ACTION RESEARCH

Like Anne Smith in the opening case study, teachers sometimes have questions that existing research findings don't fully answer. In action research, teachers conduct systematic studies of issues and problems in their own schools, with the goal of seeking more effective strategies for working with students. For example, an action research project might involve examining the effectiveness of a new teaching technique, seeking students' opinions on a new classroom policy (as Ms. Smith does), or ascertaining reasons why many students rarely complete homework assignments.

Any action research study typically involves the following steps (described in greater depth in Mills, 2011):

1. *Identify an area of focus*. The teacher–researcher begins with a problem and gathers preliminary information that might shed light on the problem, perhaps by reading relevant books or journal articles, surfing the Internet, or discussing the issue with colleagues or students. The teacher–researcher then identifies one or more specific questions to address and develops a research plan (data-collection techniques, necessary resources, schedule, etc.) for answering those questions. At this point, the teacher also seeks permission to conduct the study from school administrators and any other appropriate authorities. Depending on the nature of the study, parents' permission may be necessary as well.
2. *Collect data*. The teacher–researcher collects data relevant to the research questions. Such data might, for example, be obtained from questionnaires, interviews, achievement tests, students' journals or portfolios, existing school records (e.g., attendance patterns, school suspension rates), observations, or any combination of these.
3. *Analyze and interpret the data*. The teacher–researcher looks for patterns in the data. Sometimes the analysis involves computing particular statistics (e.g., percentages, averages, correlation coefficients)—this would be a quantitative study. At other times the analysis involves an in-depth, nonnumerical inspection of the data—this would be a qualitative study. In either case, the teacher–researcher relates the findings to the original research questions.
4. *Develop an action plan*. The final step distinguishes action research from the more traditional research studies described earlier in the chapter. In particular, the teacher–researcher uses the information collected to *take action*—for instance, to change instructional strategies, school policies, or the classroom environment.

Many colleges and universities now offer courses in action research. You can also find many inexpensive paperback books on the topic.

Developing as a Teacher

As a beginning teacher, you may initially find your role a bit overwhelming. Virtually any classroom will be one of nonstop action requiring you to be constantly attentive and on your toes, and there will always be a great deal to think about.

If you are currently enrolled in a teacher education program, you should think of your program as a very good start on the road to becoming a skillful teacher (Bransford, Darling-Hammond, & LePage, 2005; Brouwer & Korthagen, 2005). However, it is *only* a start. Developing true expertise in any profession, including teaching, takes many years of experience, although even a single year of teaching experience can make a significant difference (Berliner, 2001; Clotfelter, Ladd, & Vigdor, 2007; Henry, Bastian, & Fortner, 2011). So be patient with yourself, and recognize that occasionally feeling a bit unsure and making mistakes is par for the course. As you gain experience, you'll gradually become able to make decisions about routine situations and problems quickly and efficiently, giving you the time and energy to think creatively and flexibly about how best to teach classroom subject matter (Borko & Putnam, 1996; Bransford, Derry, Berliner, & Hammerness, 2005; Feldon, 2007).

Strategies for Studying and Learning Effectively

As you learn more about educational psychology—and especially as you learn about the nature of human thinking and learning—you'll gain many insights into how you can help students more effectively master classroom subject matter. We authors hope that you'll also gain insights into how *you yourself* can better learn and remember course material. For now, we suggest five general strategies.

- *Relate what you read to your existing knowledge and prior experiences.* For example, connect new concepts and principles with memorable childhood events, previous coursework, or your general knowledge about human beings and their behavior. In general, people learn and remember things more easily and effectively when they engage in *meaningful learning*—that is, when they connect new information and ideas to things they've previously learned.
- *Actively consider how some new information might contradict your existing beliefs.* As the earlier OOPS test may have shown you, some of what you currently "know" and believe may be sort-of-but-not-quite accurate or even out-and-out *in*accurate. People's existing beliefs can occasionally wreak havoc with new learning. For example, many students in teacher education classes reject research findings that appear to be inconsistent with their personal beliefs and experiences (Fives & Gill, 2015; Gregoire, 2003; Richardson, 2003).

  As you read about and study educational psychology, then, think about how some ideas and research findings might actually contradict and discredit your prior "knowledge." When you encounter puzzling or seemingly "wrong" ideas and findings, we hope you'll keep an open mind and, in particular, consider how and why they might have some validity and worth. Ideally, effective learners undergo *conceptual change*: They revise their existing notions to accommodate new and discrepant information.
- *Tie abstract concepts and principles to concrete examples.* Children become increasingly able to think about abstract ideas as they get older, but people of *all* ages can more readily understand and remember abstract information when they tie it to concrete objects and events. Short examples and lengthier case studies that involve real children and teachers, videos that depict classrooms in action, Experiencing Firsthand exercises such as the OOPS test—all of these can enhance your understanding and memory of new concepts and help you recognize them when you see them in your own work with children and adolescents.

- *Elaborate on what you read, going beyond it and adding to it.* Earlier in the chapter we mentioned that the process of *elaboration*—embellishing on new information in some way—enhances learning and memory of the information. So try to think *beyond* the information you read. Draw inferences from the ideas presented. Generate new examples of concepts. Identify your own educational applications of various principles of learning, development, and motivation.
- *Periodically check yourself to make sure you remember and understand what you have read.* There are times when even the most diligent students don't concentrate on what they're reading—when they're actually thinking about something else as their eyes go down the page. So stop once in a while (perhaps once every two or three pages) to make sure you've really learned and understood the things you've been reading. Try to summarize the material. Ask yourself questions about it, and make sure everything makes sense to you. Check your mastery of various concepts by doing activities and taking self-check quizzes sprinkled throughout a chapter in the Pearson etext. And tackle the Practice for Your Licensure Exam exercise that appears after each chapter summary.

When all is said and done, your goal in studying educational psychology isn't to memorize enough facts that you can get good grades on tests and quizzes. Instead, your goal is to become the best teacher—and also the best *learner*—you can possibly be. As you look forward to your entry into the teaching profession, we urge you to be confident that with time, practice, a solid understanding of how children and adolescents learn and develop, a large toolkit of instructional strategies, and every student's best interests at heart, you can truly make a significant difference in young people's lives.

Activity 1.5 — Classifying Research Studies

This activity gives you practice in distinguishing among descriptive, correlational, and experimental research It is accompanied by Activity data 1.5.

1. Look at Activity data 1.5. Consider whether each of the results described reflects descriptive, correlational, or experimental study. In each case, you should explain your reasoning. Attempt to do on your own without referring to the answers provided. Check answers provided and compare to your answers ONLY after you have completed the activity on your own.

Activity data 1.5 below.

Study #1
Ormrod and Jenkins (1989) reported that in a group of 20 third and fourth graders, the predominant strategy the children used to learn a list of spelling words was saying the letters of each word out loud.

Study #2
In a study by Palardy (1969), first-grade teachers were asked whether they believed that girls were better readers than boys. Some teachers said that girls were better readers than boys; others said that girls and boys had equal reading ability. At the beginning of the school year, there were no differences in reading readiness between girls and boys for either group of teachers. At the end of the year, reading achievement tests yielded these average scores:

Teacher Expectations	Girls' Test Scores	Boys' Test Scores
Girls are better readers	96.7	89.2
Girls and boys are equal	96.2	96.5

Study #3
Laosa (1982) has reported that parents with higher educational levels are more likely to read to their children than parents with lower levels.

Study #4
Wakshlag, Reitz, and Zillmann (1982) showed first and second graders an educational television program with either fast-tempo or slow-tempo music in the background. Students who had the slow-tempo music learned more from the program than students who had the fast-tempo music.

Study #5
After analyzing tape recordings of numerous science classrooms in action, Rowe (1974) reported that when the teachers asked a student a question, they waited an average of only one second for the student to reply before repeating or rephrasing the question, asking a different question, or calling on another student.

Study #6
In a study of 20,364 high school seniors, students who spent more time on their homework got higher grades (Keith, 1982).

Study #7
In a study with Spanish-speaking kindergartners by Dreisbach and Keogh (1982), some students were given training in test-taking skills, and other students spent the same amount of time drawing pictures. The students with the training later got higher scores on a school readiness test than did the students who had no training.

Correct answers are as follows:

Study #1: Descriptive—It describes the most common strategy used to learn spelling words, but it does not relate this strategy to another variable.

Study #2: Correlational—Teachers' beliefs at the beginning of the school year (either that girls and boys read equally well, or that girls are better readers) are consistent with the pattern of reading achievement test scores at the end of the year. The experimenter does not specifically manipulate teachers' beliefs but examines them as they already exist.

Study #3: Correlational—There is a relationship between parental education and the amount of reading to children, but the educational level of the parents is not manipulated by the experimenter.

Study #4: Experimental—The experimenters manipulate the tempo of music that the children hear.

Study #5: Descriptive—The amount of wait time after teacher questions is reported, but it is not related to another variable.

Study #6: Correlational—Time doing homework and GPAs are related, but the amount of time each student does homework is not controlled.

Study #7: Experimental—The experimenters determine which students get the training and which do not.

Islamic Online University
Lecture Notes for Modules 3 & 4

TEXTBOOK CHAPTER 2: COGNITIVE AND LINGUISTIC DEVELOPMENT

LEARNING OUTCOMES

1 Describe four principles portraying the general nature of child development and the interactive roles of heredity and environment in guiding it.
2 Explain how the brain and its development influence children's thinking and learning.
3 Ability to apply Piaget's theory of cognitive development to classroom practice.
4 Ability to apply Vygotsky's theory of cognitive development to classroom practice.
5 Describe developmental changes in language during the school years, and explain how you might adapt instruction to children with diverse linguistic abilities and needs.

CASE STUDY: APPLE TARTS

Ms. Lombard's fourth-grade class has learned how to add and subtract fractions but not yet studied how to divide by fractions. Nevertheless, students are working in small groups to tackle the following problem, which requires dividing 20 by $\frac{3}{4}$:

> Mom makes small apple tarts, using three-quarters of an apple for each small tart. She has 20 apples. How many small apple tarts can she make? (J. Hiebert et al., 1997, p. 118)[1]

One group has already agreed that Mom can use three-fourths of each apple to make 20 tarts, with one-fourth of each apple being left to make additional tarts.

Liz:	So you've got twenty quarters *left*.
Jeanette:	Yes, . . . and twenty quarters is equal to five apples, . . . so five apples divided by—
Liz:	Six, seven, eight.
Jeanette:	But three-quarters equals three.
Kerri:	But she can't make only three apple tarts!
Jeanette:	No, you've still got twenty.
Liz:	But you've got twenty quarters, if you've got twenty quarters you might be right.
Jeanette:	I'll show you.
Liz:	No, I've drawn them all here.
Kerri:	How many quarters have you got? Twenty?
Liz:	Yes, one quarter makes five apples and out of five apples she can make five tarts which will make that twenty-five tarts and then she will have, wait, one, two, three, four, five quarters, she'll have one, two, three, four, five quarters. . . . (J. Hiebert et al., 1997, p. 121)

Eventually the group arrives at the correct answer: Mom can make 26 tarts and will have half an apple left over.

- Is the apple-tarts problem developmentally appropriate for Ms. Lombard's students? Why or why not?
- What advantages might there be for making this task a group activity?

Case Study Analysis

Apple Tarts

Why do the girls find this problem so difficult?

The problem is difficult because the girls have to apply an abstract concept (division of fractions) that they haven't yet mastered to solve a concrete problem. Note they are most successful when they talk about the problem in concrete terms — "In each apple there is a quarter left … and twenty quarters is equal to five apples" — and apply computational processes that they do know (addition of fractions).

Discussion Topics

1. Do children who reach early milestones (e.g., walking, talking) sooner than their peers also have higher academic ability later on?
   Note: Any correlations along this line tend to be low or nonexistent
2. To what extent is intelligence influenced by heredity and environment? To what extent are personality characteristics influenced by heredity and environment?
   (You may want to conclude this discussion by saying that environment, including the school environment, does have a significant impact on a child's development; teachers and schools *do* make a difference. At the same time, teachers must remember that environment can facilitate developmental changes only when maturational processes also allow these changes to occur.)
3. How important is ongoing brain research to the work of teachers? In what ways can it inform the practice of teaching and learning?
4. What kinds of scaffolding do parents and teachers use to help children develop new skills? (Students should think of specific, concrete examples of scaffolding in everyday childrearing and classroom instruction.)
5. Can the theories of Piaget and Vygotsky be applied in combination in the classroom? What kind of activities might utilize both theories?
6. To what extent and in what contexts should students' local dialects be encouraged or discouraged in the classroom?

General Principles of Human Development

Four general principles characterize children's physical, cognitive, personal, and social development.

- *The sequence of development is somewhat predictable.* Researchers have observed many universals in development; that is, they've seen similar patterns in how children change over time despite considerable differences in the environments in which the children grow up. Some of this universality is marked by the acquisition of developmental milestones—new, developmentally more advanced behaviors—in predictable sequences. For example, children must be able to walk before they can run and jump, and they must be able to count and work with whole numbers before they become capable of using fractions in mathematical problem solving.
- *Children develop at different rates.* Not all children reach particular milestones at the same age: Some reach them earlier, some later. Accordingly, we're apt to see considerable *diversity* in students' developmental accomplishments at any single grade level. As teachers, we should never jump to conclusions about what individual students can and cannot do based on age alone. For example, although Ms. Lombard's apple-tarts problem appears to be developmentally appropriate for some of her students, it might be too advanced for others.
- *Development is often marked by periods of relatively rapid growth (spurts) between periods of slower growth (plateaus).* Development doesn't necessarily proceed at a constant rate. For example, toddlers may speak with a limited vocabulary and one-word "sentences" for several months, yet sometime around their second birthday their vocabulary expands rapidly and their sentences become longer and longer within just a few weeks. And after seemingly stalling out height-wise, many young adolescents undergo an adolescent growth spurt, shooting up several inches within a year or so. Occasionally children even take a temporary step *backward*, apparently because they're in the process of overhauling a particular physical or cognitive skill and are about to make a major leap forward (Gershkoff-Stowe & Thelen, 2004; Morra, Gobbo, Marini, & Sheese, 2008).

  Some developmental theorists have suggested that such patterns of uneven growth reflect distinctly different periods, or *stages*, in development; you'll see an example in the discussion of Piaget's theory later in this chapter. Other theorists instead believe that most aspects of development can best be characterized as reflecting general *trends* that can't really be broken into discrete stages. Either way, early developmental advancements almost certainly provide a foundation on which later advancements can build—hence the predictable *this-before-that* nature of many developmental progressions.
- *Heredity and environment interact in their effects on development.* Virtually all aspects of development are influenced either directly or indirectly by a child's genetic makeup. For example, soon after birth children begin to show genetic inclinations, or *temperaments*, that predispose them to respond to physical and social events in certain ways—perhaps to be calm or irritable, outgoing or shy, cheerful or fearful. Not all inherited characteristics appear so early, however. Heredity continues to guide a child's growth through maturation—a gradual, genetically driven acquisition of more advanced physical and neurological capabilities over the course of childhood and adolescence. For example, motor skills such as walking, running, and jumping develop primarily as a result of neurological development, increased strength, and increased muscular control—changes that are largely determined by inherited biological "instructions." And genetically driven maturational changes in the brain have a significant impact on children's increasing ability to think and behave effectively and efficiently (more about this point shortly).

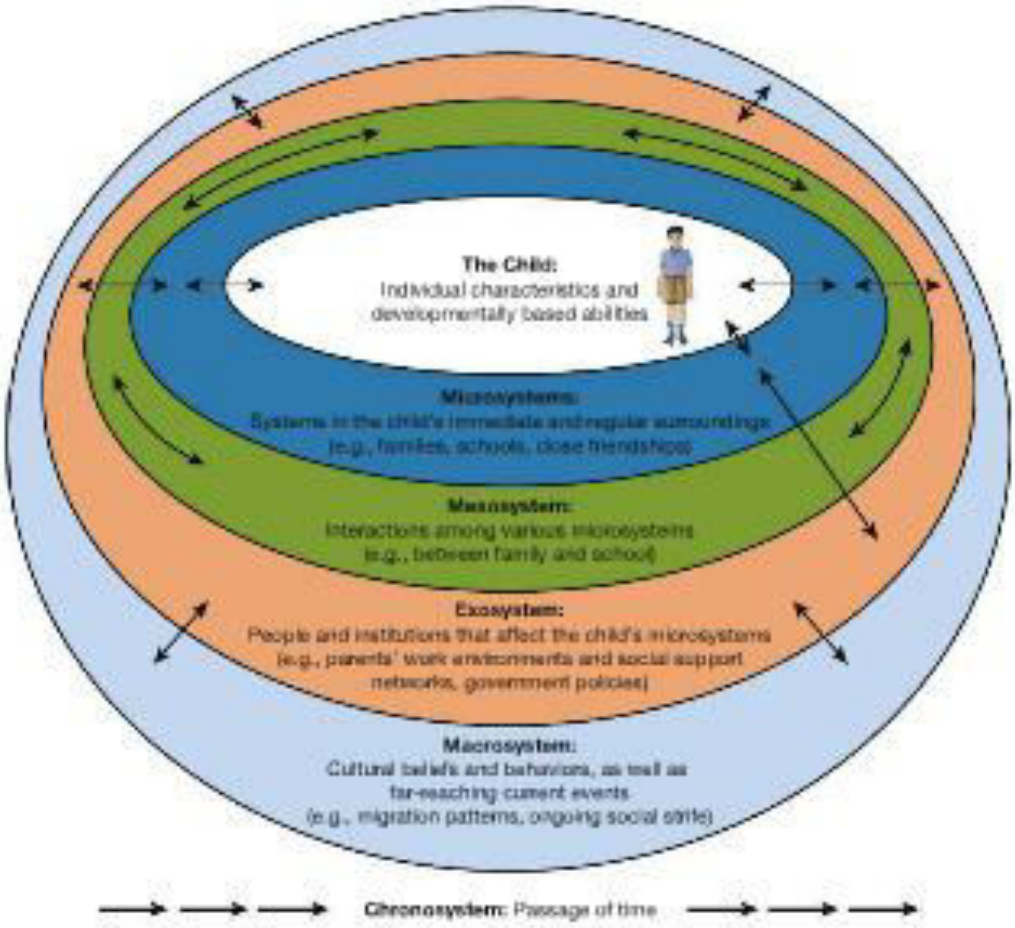
THE MULTIPLE LAYERS OF ENVIRONMENTAL INFLUENCE: BIOECOLOGICAL SYSTEMS AND THE IMPORTANCE OF CULTURE

As we consider the various ways in which the environment might influence children's development, we must be careful that we don't limit our thinking only to children's immediate surroundings. In fact, as developmental theorist Urie Bronfenbrenner has pointed out in his bioecological systems theory, any large society encompasses several "layers" of environment that all have significant impacts on children's development and are, in turn, either directly or indirectly influenced by the other layers and by the children themselves (Bronfenbrenner, 2005; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998).

Figure 2.1 depicts the various layers of influence that Bronfenbrenner has proposed. More specifically:

1. The *child* brings certain individual characteristics (e.g., unique temperaments and physiological features) and age-related developmental acquisitions (e.g., cognitive abilities and interpersonal skills) that influence the child's behaviors in any given situation.
2. The child is regularly immersed in certain *microsystems*—certain everyday contexts (e.g., family, school, friendships) that both influence and are influenced by the child's characteristics and behaviors.
3. The microsystems in which a child lives and grows *influence one another* in what Bronfenbrenner has called a *mesosystem.* For example, a temperamentally hyperactive child might initially elicit stringent disciplinary actions at school (one microsystem), but concerned parents (another microsystem) might actively seek out the child's teachers and suggest alternative strategies that can channel the child's behaviors into productive activities.
4. Encompassing the day-to-day contexts in which a child lives, works, and plays is a broader *exosystem,* which includes people and institutions that indirectly affect the child's development through their influences on various microsystems. For example, the nature of parents' employment can affect their ability to provide adequate living quarters, nutrition, and health care for their family, and a good social support network can give parents advice,

FIGURE 2.1 In Bronfenbrenner's bioecological systems perspective, growing children affect and are affected by multiple systems that are nested within one another and change over time.



assistance, and emotional support in challenging circumstances. Meanwhile, local and federal agencies and policies may or may not support teachers and schools in their efforts to nurture children's cognitive development and social well-being.

5. A child's exosystem is enmeshed within an even broader *macrosystem*, which includes a society's general beliefs, ideological perspectives, and behavior patterns, as well as far-reaching current events (e.g., war, migration patterns, ongoing social or political strife).
6. Children and the systems in which they grow up are by no means static entities. Instead, they all change over time—in part because they influence one another—in what Bronfenbrenner has called a *chronosystem* (see the bottom set of arrows in Figure 2.1). For example, teachers' instructional practices might change as academic researchers report new research findings, government agencies might provide websites that help parents and teachers more effectively foster children's cognitive development, and society's general beliefs and practices can change as two or more subgroups regularly interact. In general, children's environments are *dynamic systems* encompassing mutually influencing variables that are in constant flux (also see C. D. Lee, 2010; Thelen & Smith, 1998).

Role of the Brain in Learning and Development

One key player in children's development is, of course, the brain. The human brain is an incredibly complicated organ that includes several *trillion* cells. About 100 billion of them are nerve cells, or neurons, that are microscopic in size and interconnected in countless ways. Some neurons receive information from the rest of the body, others synthesize and interpret that information, and still others send messages that tell the body how to respond to its present circumstances. Accompanying neurons are perhaps 1 to 5 trillion glial cells, which serve a variety of specialized functions that enhance the functioning of neurons or in other ways keep the brain going.

Every neuron has numerous branchlike structures, called *dendrites*, that receive messages from other neurons (see Figure 2.2). Every neuron also has an *axon*, a long, armlike structure that transmits information on to still other neurons. The axon may branch out many times, and the ends of its branches have *terminal buttons* that contain certain chemical substances (more about these substances in a moment). For some (but not all) neurons, much of the axon has a white, fatty coating called a *myelin sheath*.

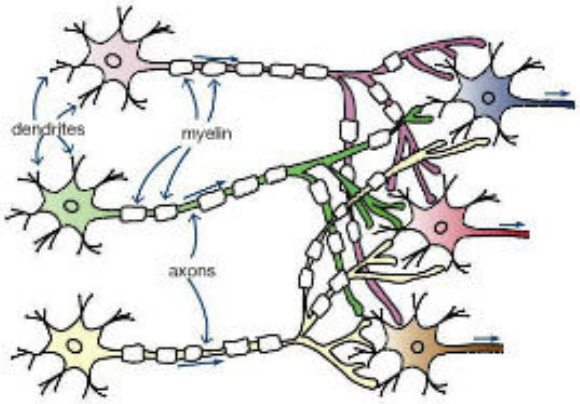
When a neuron's dendrites are stimulated by other neurons—which might also be in the brain or, instead, might extend from other parts of the body—the dendrites become electrically charged. If the total charge reaches a certain level, the neuron fires, sending an electrical impulse along its axon to the terminal buttons. If the axon has a myelin sheath, the impulse travels quite rapidly because it leaps from one gap in the myelin to the next, almost as if it were playing leapfrog. If the axon doesn't have a myelin sheath, the impulse travels more slowly.

Curiously, neurons don't actually touch one another. Instead, they send chemical messages to their neighbors across tiny spaces known as synapses. When an electrical impulse moves along a neuron's axon, it signals the terminal buttons to release chemicals known as neurotransmitters that travel across the synapses and stimulate neighboring neurons. Any single neuron may have synaptic connections with hundreds or even thousands of other neurons (Goodman & Tessier-Lavigne, 1997; Lichtman, 2001).

With these basics in mind, let's consider four key points about the brain and its role in cognitive development.

- *Different parts of the brain have different specialties, but they all work closely with one another.* Brain structures in the lower and middle parts of the brain specialize in essential physiological processes (e.g., breathing), habitual body movements (e.g., riding a bicycle), and basic perceptual skills (e.g., diverting attention to potentially life-threatening stimuli). Complex, conscious thinking takes place primarily in the cortex, which rests on the top and sides of the brain like a thick, lumpy toupee. The part of the cortex located just behind the forehead, known as the *prefrontal cortex*, is largely responsible for a wide variety of

FIGURE 2.2 Neurons and their interconnections.



very human activities, including sustained attention, planning, reasoning, decision making, coordination of complex activities, and inhibition of nonproductive thoughts and behaviors. Other areas of the cortex are actively involved in interpreting visual and auditory information, identifying the spatial characteristics of objects and events, and retaining general knowledge about the world.

To some degree, the left and right halves of the cortex—its two *hemispheres*—also have somewhat distinct specialties. For most people, the left hemisphere takes primary responsibility for language and logical thinking, whereas the right hemisphere is more dominant in visual and spatial tasks (Byrnes, 2001; Ornstein, 1997; Siegel, 2012). Yet contrary to a popular belief, people rarely, if ever, think exclusively in one hemisphere. There's really no such thing as "left-brain" or "right-brain" thinking: The two hemispheres constantly collaborate in day-to-day tasks. In fact, learning or thinking about virtually anything, even a fairly simple idea, tends to be *distributed* across many parts of the brain (Bressler, 2002; Gonsalves & Cohen, 2010; Haxby et al., 2001).

- *Learning and cognitive development involve changes in synapses, neurons, and glial cells.* Much of human learning involves strengthening existing synapses between neurons or else forming new ones. Sometimes, however, making progress actually involves *eliminating* synapses. Effective learning requires not only that people think and do certain things but also that they *not* think and do other things—in other words, that they inhibit tendencies to think or behave in particular ways (C. N. Davidson, 2011; Lichtman, 2001; Merzenich, 2001). In addition, a good deal of learning seems to involve the formation of new neurons or glial cells (Koob, 2009; Spalding et al., 2013).
- *Developmental changes in the brain enable increasingly complex and efficient thought.* Neurons begin to form synapses long before a child is born. But shortly after birth, the rate of synapse formation increases dramatically. Neurons sprout new dendrites in many directions, and so they come into contact with a lot of their neighbors, especially in the first 2 or 3 years of life. Much of this early synaptogenesis appears to be driven primarily by genetic programming rather than by learning experiences. Thanks to synaptogenesis, children in the elementary grades have many more synapses than adults do (Bruer, 1999; C. A. Nelson, Thomas, & de Haan, 2006).

  As children encounter different stimuli and experiences in their daily lives, some synapses come in quite handy and are used repeatedly. Others are largely useless, and these gradually fade away through another genetically driven process known as synaptic pruning, a process that continues throughout the elementary and secondary school years and into adulthood. Most synaptic pruning is a *good* thing—not a bad one—because it eliminates "nuisance" synapses that are inconsistent with typical environmental events and appropriate responses. Synaptic pruning, then, may be Mother Nature's way of making the brain more efficient (Bruer & Greenough, 2001; Bryck & Fisher, 2012; Huttenlocher & Dabholkar, 1997).

  Another important developmental process in the brain is myelination. When neurons first develop, their axons have no myelin sheath. As they acquire this myelin over time, they fire much more quickly, greatly enhancing the brain's overall efficiency. Myelination continues throughout childhood, adolescence, and early adulthood, especially in the cortex (Giedd et al., 2012; Merzenich, 2001; Paus et al., 1999).

  In addition, the onset of puberty is marked by significant changes in hormone levels, which affect the continuing maturation of brain structures and possibly also affect the production and effectiveness of neurotransmitters (Kolb, Gibb, & Robinson, 2003; Shen et al., 2010; E. F. Walker, 2002). Such changes can have an impact on adolescents' functioning in a variety of areas, including attention, planning, and impulse control. To some degree, adolescents' abilities to learn and respond appropriately may temporarily *decrease* until brain functioning restabilizes (McGivern, Andersen, Byrd, Mutter, & Reilly, 2002; Shen et al., 2010; Steinberg, 2009).
- *The brain remains adaptable throughout life.* Some aspects of cognitive development appear to have sensitive periods in which certain kinds of environmental stimulation are crucial. For example, if infants don't have normal exposure to patterns of light (e.g., if congenital cataracts make them functionally blind), they may soon lose the ability to see normally. And if children don't hear spoken language in the first few years of life, they're apt to have trouble mastering some of its complexities once they *do* begin to hear it (more about this point later

in the chapter). However, seeing patterned light and hearing spoken language are *normal* experiences, not exceptional ones. There is *no* evidence to indicate that sensitive periods exist for traditional academic subjects such as reading and mathematics.

From a physiological standpoint, the brain's ability to reorganize itself in order to adapt to changing circumstances—that is, its plasticity—persists throughout the life span (Chein & Schneider, 2012; Kolb et al., 2003; C. A. Nelson et al., 2006). The early years are important for development, to be sure, but so are the later years. For most topics and skills, there isn't a single "best" or "only" time to learn (Bruer, 1999; Byrnes & Fox, 1998; Geary, 1998, 2008). The human brain never goes into lockdown mode.

As researchers gradually pin down how the brain works and develops, they're also beginning to get clues about how we can best foster children's and adolescents' cognitive development; three research-based recommendations are presented in the Applying Brain Research feature "Taking Developmental Changes in the Brain into Account." Even so, current knowledge of brain physiology doesn't yield many specifics about how best to foster students' learning and cognitive development (Byrnes, 2007; G. A. Miller, 2010; Varma, McCandliss, & Schwartz, 2008). By and large, if we want to understand the nature of human learning and cognitive development, we must look primarily at what psychologists, rather than neurologists, have discovered. Two early theories—those of Jean Piaget and Lev Vygotsky—have been especially influential in molding contemporary views of how children learn and develop.

MyEdLab **Self-Check 2.2**

MyEdLab **Application Exercise 2.1.** In this exercise, see if you can detect common teacher and parent misconceptions about how the brain develops.

Piaget's Theory of Cognitive Development

PIAGET'S BASIC ASSUMPTIONS

Piaget introduced a number of ideas and concepts to describe and explain the changes in logical thinking he observed in children and adolescents.

- *Children are active and motivated learners.* Piaget believed that children are naturally curious about their world and actively seek out information to help them make sense of it. They continually experiment with the objects they encounter, manipulating them and observing the effects of their actions.
- *Children construct rather than absorb knowledge.* In their day-to-day experiences, children don't just passively soak up a collection of isolated facts. Instead, they pull their experiences together into an integrated view of how the world operates. For example, by observing that objects always fall down (never up) when released, children begin to construct a basic understanding of gravity. As they interact with family pets, visit farms and zoos, and look at picture books, they develop more complex understandings of animals. Because Piaget proposed that children construct their own beliefs and understandings from their experiences, his theory is sometimes called a *constructivist* theory or, more generally, constructivism.

  In Piaget's terminology, the things children do and know are organized as schemes—groups of similar actions or thoughts that are used repeatedly in response to the environment. Initially, children's schemes are largely behavioral in nature, but over time they become increasingly mental and, eventually, abstract. For example, an infant may have a putting-things-in-mouth scheme that she applies to a variety of objects, including her thumb, cookies, and toys. A 7-year-old may have a scheme for identifying snakes that includes their long, thin bodies, lack of legs, and slithery nature. A 13-year-old may have a scheme for what constitutes *fashion*, allowing him to classify certain peers as being either really cool or "total losers."

  Over time, children's schemes are modified with experience, and many become integrated with one another. For instance, children begin to take hierarchical interrelationships into account: They learn that poodles, cocker spaniels, and German shepherds are all dogs; that dogs, snakes, and birds are all animals; and that both animals and plants are living creatures. A progressively more organized body of knowledge and thought processes allows children to think in increasingly complex and logical ways.

- *Children continually learn new things through two complementary processes: assimilation and accommodation.* Assimilation involves responding to or thinking about an object or event in a way that's consistent with an existing scheme. For example, an infant may assimilate a new teddy bear into her putting-things-in-mouth scheme. A 7-year-old may quickly identify a new slithery creature in the garden as a snake. A 13-year-old may readily label a classmate's apparel or hairstyle as being either quite fashionable or "soooo yesterday."

  But sometimes children can't easily interpret and respond to a new object or event using existing schemes. In these situations one of two forms of accommodation occurs: Children either (1) modify an existing scheme to account for the new object or event or (2) form a new scheme to deal with it. For example, an infant may have to open her mouth wider than usual to accommodate a teddy bear's fat paw. A 13-year-old may have to revise his existing scheme of fashion according to changes in what's hot and what's not. A 7-year-old who encounters a long, slithery creature with four legs can't apply the *snake* scheme (snakes don't have legs) and thus, after some research, may acquire a new scheme—*salamander*.

  Assimilation and accommodation typically work hand in hand as children develop their knowledge and understanding of the world. Children interpret each new event within the

context of their existing knowledge (assimilation) but at the same time may modify their knowledge as a result of the new event (accommodation). Accommodation rarely happens without assimilation: Children can benefit from, or accommodate to, new experiences only when they can relate those experiences to their current knowledge and beliefs.

- *Interactions with one's physical and social environments are essential for cognitive development.* According to Piaget, active experimentation with the physical world is critical for cognitive growth. By exploring and manipulating physical objects—for instance, fiddling with sand and water, playing games with balls and bats, and conducting science experiments—children see the effects of erosion, discover principles related to force and gravity, and so on.

  In Piaget's view, interaction with other people is equally important. Frequent social interactions—both pleasant (e.g., conversations) and unpleasant (e.g., conflicts about sharing and fair play)—help young children come to realize that different people see things differently and that their own view of the world isn't necessarily completely accurate or logical. And as children get older, discussions and disagreements about complex issues and problems—for instance, the apple-tarts problem in the opening case study—can help them recognize and reexamine inconsistencies in their own reasoning.
- *A process of equilibration promotes progression toward increasingly complex thought.* Piaget suggested that children are often in a state of equilibrium: They can comfortably interpret and respond to new events using existing schemes. But as children grow older and expand their horizons, they sometimes encounter situations for which their current knowledge and skills are inadequate. Such situations create disequilibrium, a sort of mental discomfort that spurs them to try to make sense of what they're observing. By replacing, reorganizing, or better integrating certain schemes (i.e., through accommodation), children can better understand and address previously puzzling events. The process of moving from equilibrium to disequilibrium and back to equilibrium again is known as equilibration. In Piaget's view, equilibration and children's intrinsic desire to achieve equilibrium promote the development of more complex levels of thought and knowledge.

As an example, let's return to Brian's responses to the beads problem. Recall that the adult asked Brian to draw two necklaces, one made with the brown beads and one made with the wooden beads. The adult presumably hoped that after Brian drew a brown-and-white necklace that was longer than an all-brown necklace, he would notice that his drawings were inconsistent with his statement that there were more brown beads. The inconsistency might have led Brian to experience disequilibrium, perhaps to the point where he would revise his conclusion. In this case, however, Brian was apparently oblivious to the inconsistency, remained in equilibrium, and thus had no need to revise his thinking.

An event that contradicts what we currently know and believe about the world creates *disequilibrium*—a feeling of discomfort that motivates us to try to resolve the contradiction in some way.

- *In part as a result of maturational changes in the brain, children think in qualitatively different ways at different ages.* Long before researchers knew much about how the brain changes with age, Piaget speculated that it *does* change in significant ways and that such changes enable more complex thought processes. He suggested that major neurological changes take place when children are about 2 years old, again when they're 6 or 7, and yet again around puberty. Changes at each of these times allow new abilities to emerge, such that children progress through a sequence of stages that reflect increasingly sophisticated thought. As you've already learned, the brain does, in fact, continue to develop throughout childhood and adolescence, but whether some of its changes enable the cognitive advancements Piaget described is still an open question.

PIAGET'S PROPOSED STAGES OF COGNITIVE DEVELOPMENT

Piaget proposed that as a result of brain maturation, innumerable experiences in children's physical and social environments, and children's natural desire to make sense of and adapt to their world, cognitive development proceeds through four distinct stages, with the last three being constructed from children's accomplishments in preceding stages (e.g., Piaget, 1971). Thus, the stages are *hierarchical*—each stage provides a foundation for any subsequent ones—and so children progress through them in a particular order.

Table 2.1 summarizes Piaget's proposed stages and presents examples of abilities acquired during each one. As you look at the table, please keep three things in mind. First, some children are apt to be in *transition* from one stage to the next, displaying characteristics of two adjacent stages at the same time. Second, as children gain abilities associated with more advanced stages, they don't necessarily leave behind the characteristics they acquired in previous stages. Finally, many developmental theorists suggest—and Piaget himself acknowledged—that the four stages better describe how children and adolescents *can* think, rather than how they always *do* think, at any particular age (Flavell, 1994; Halford & Andrews, 2006; Klaczynski, 2001; Tanner & Inhelder, 1960).

COMPARE/CONTRAST

TABLE 2.1 • Piaget's Proposed Stages of Cognitive Development

STAGE	PROPOSED AGE RANGE[a]	GENERAL DESCRIPTION	EXAMPLES OF ABILITIES ACQUIRED
Sensorimotor Stage	Begins at birth	Schemes are based largely on behaviors and perceptions. Especially in the early part of this stage, children cannot think about things that are not immediately in front of them, and so they focus on what they are doing and seeing at the moment.	• **Trial-and-error experimentation with physical objects:** Exploration and manipulation of objects to determine their properties • **Object permanence:** Realization that objects continue to exist even when removed from view • **Symbolic thought:** Representation of physical objects and events as mental entities (symbols)
Preoperational Stage	Emerges at about age 2	Thanks in part to their rapidly developing symbolic thinking abilities, children can now think and talk about things beyond their immediate experience. However, they do not yet reason in logical, adultlike ways.	• **Language:** Rapid expansion of vocabulary and grammatical structures • **Extensive pretend play:** Enactment of imaginary scenarios with plots and assigned roles (e.g., mommy, doctor, Superman) • **Intuitive thought:** Some logical thinking (especially after age 4), but based primarily on hunches and intuition rather than on conscious awareness of logical principles
Concrete Operations Stage	Emerges at about age 6 or 7	Adultlike logic appears but is limited to reasoning about concrete, real-life situations.	• **Distinction between one's own and others' perspectives:** Recognition that one's own thoughts and feelings may be different from those of others and do not necessarily reflect reality • **Class inclusion:** Ability to classify objects as belonging to two or more categories simultaneously • **Conservation:** Realization that amount stays the same if nothing is added or taken away, regardless of alterations in shape or arrangement
Formal Operations Stage	Emerges at about age 11 or 12[b]	Logical reasoning processes are applied to abstract ideas as well as to concrete objects and situations. Many capabilities essential for advanced reasoning in science and mathematics appear.	• **Logical reasoning about abstract, hypothetical, and contrary-to-fact ideas:** Ability to draw logical deductions about situations that have no basis in physical reality • **Proportional reasoning:** Conceptual understanding of fractions, percentages, decimals, and ratios • **Formulation of multiple hypotheses:** Ability to identify two or more competing hypotheses about possible cause-and-effect relationships • **Separation and control of variables:** Ability to test hypotheses by manipulating one variable while holding other relevant variables constant • **Idealism:** Ability to envision alternatives to current social and political practices, sometimes with little regard for what is realistically possible under existing circumstances

[a]The age ranges presented in the table are averages; some children reach more advanced stages a bit earlier, others a bit later. Also, some children may be in transition from one stage to the next, displaying characteristics of two adjacent stages at the same time.
[b]Researchers have found considerable variability in when adolescents begin to show reasoning processes consistent with Piaget's formal operations stage. Furthermore, not all cultures value or nurture formal operational logic, perhaps because it is largely irrelevant to people's daily lives and tasks in those cultural groups.

The preoperational, concrete operations, and formal operations stages all occur during the school years, and so we'll look at these three stages more closely.

PREOPERATIONAL STAGE (AGE 2 THROUGH AGE 6 OR 7)

In the early part of the **preoperational stage**, children's language skills virtually explode, and the many words in their rapidly increasing vocabularies serve as *symbols* that enable them to mentally represent and think about a wide variety of objects and events. However, preoperational thought has some definite limitations, especially when compared to the concrete operational thinking that emerges later. For example, Piaget described young children as exhibiting **preoperational egocentrism**: They don't yet have sufficient reasoning abilities to look at a situation as someone else might look at it. Thus, preschoolers might play games together without checking to be sure they're all playing by the same rules, and they may tell stories in which they leave out details that are critical for listeners' understanding.

Young children's thinking also tends to be somewhat illogical at times, at least from an adult's point of view. We've already seen how young children have difficulty with class inclusion problems (recall Brian's insistence that the brown beads outnumber the wooden ones). In addition, they're apt to have trouble with **conservation**: They fail to realize that if nothing is added or taken away, the amount of a substance or set of objects must stay the same regardless of changes in the shape or arrangement of items. As illustrations, consider what happens when we present two conservation tasks to 5-year-old Nathan:

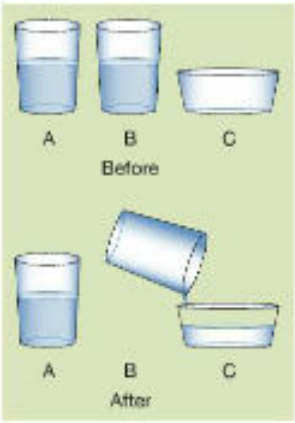


FIGURE 2.3 Do Glasses A and C contain the same amount of water?

Conservation of liquid: We show Nathan the three glasses in Figure 2.3. We ask him whether Glasses A and B contain the same amount of water, and he replies confidently that they do. We then pour the water from Glass B into Glass C and ask him whether A and C have the same amount. Nathan replies, "No, that glass [pointing to Glass A] has more because it's taller."

Conservation of number: We next show Nathan two rows of seven pennies each, like so:

Nathan counts the pennies in each row and agrees that the two rows have the same amount. We spread the second row out, and the pennies now look like this:

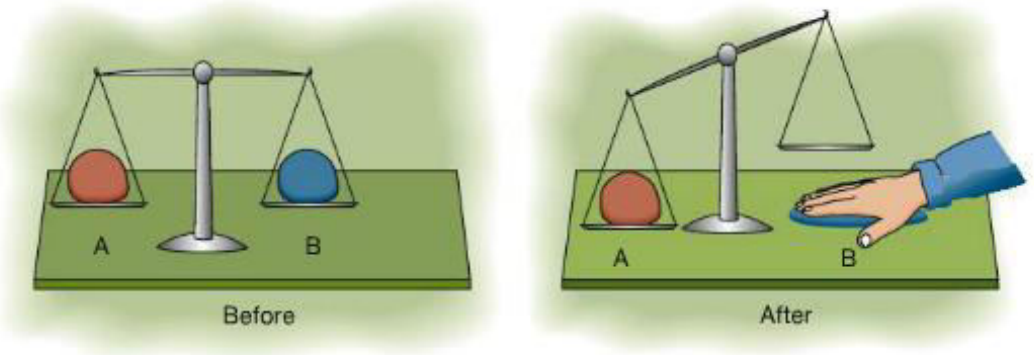
When we ask Nathan whether the two rows still have the same number, he replies, "No, this one [pointing to the bottom row] has more because it's longer."

As children approach the later part of the preoperational stage, perhaps at around age 4 or 5, they show early signs of adultlike logic. For example, they sometimes draw correct conclusions about class inclusion and conservation problems. But they base their reasoning on hunches and intuition rather than on any conscious awareness of underlying logical principles, and thus they can't yet explain *why* their conclusions are correct.

CONCRETE OPERATIONS STAGE (AGE 6 OR 7 THROUGH AGE 11 OR 12)

Piaget proposed that as children enter the **concrete operations stage**, their thought processes become organized into larger systems of mental processes—*operations*—that allow them to think more logically than they have previously. They now realize that their own perspectives and feelings aren't necessarily shared by others and may reflect personal opinions rather than reality. They also exhibit such logical reasoning abilities as class inclusion and conservation. For example, they should readily conclude, as you presumably did in an earlier Experiencing Firsthand exercise, that in a group of brown and white wooden beads, there obviously must be more wooden beads than brown ones.

FIGURE 2.4 Conservation of weight: Ball A and Ball B initially weigh the same. When Ball B is flattened into a pancake shape, how does its weight now compare with that of Ball A?



Children continue to refine their newly acquired logical thinking capabilities for several years. For instance, some forms of conservation, such as conservation of liquid and conservation of number, appear at age 6 or 7, whereas other forms emerge later. Consider the problem in Figure 2.4. Using a balance scale, an adult shows a child that two balls of clay have the same weight. One ball is removed from the scale and smashed into a pancake shape. Does the pancake weigh the same as the unsmashed ball, or are the weights different? Children typically don't achieve conservation of weight—they don't realize that the flattened pancake weighs the same as the round ball it was earlier—until about age 9 (Morra et al., 2008).

Although students displaying concrete operational thought show many signs of logical thinking, their cognitive development isn't yet complete. For example, they have trouble understanding abstract ideas, and they may struggle with problems involving fractions and other proportions, as Liz, Jeanette, and Kerri do in the opening case study.

FORMAL OPERATIONS STAGE (AGE 11 OR 12 THROUGH ADULTHOOD)

Once children acquire abilities characterizing Piaget's formal operations stage, they can think about concepts that have little or no basis in concrete reality—for instance, abstract concepts, hypothetical ideas, and contrary-to-fact statements. Thus, they begin to find underlying meanings in proverbs such as *A rolling stone gathers no moss* and *Don't put the cart before the horse.* They can also recognize that what is logically valid might be different from what is true in the real world. For example, recall the earlier children-basketballs-jellybeans problem: *If* all children are basketballs and *if* all basketballs are jellybeans, then formal operational thinkers can logically conclude that all children must be jellybeans, even though in the real world children *aren't* jellybeans.

From Piaget's perspective, students' mathematical abilities are likely to improve when formal operational thinking develops. Abstract math problems, such as word problems, should become easier to solve. And students should become capable of understanding such concepts as *negative number, pi* (π), and *infinity*—for instance, they should now comprehend how temperature can be below zero and how two parallel lines will never touch even if they go on forever. In addition, because students can now understand proportions (see Table 2.1), they can more easily use fractions, decimals, and ratios when solving problems.

Scientific reasoning is also likely to improve when students are capable of formal operational thought. Three of the formal operational abilities listed in Table 2.1—reasoning logically about hypothetical ideas, formulating multiple hypotheses, and separating and controlling variables—together allow many adolescents to use the *scientific method,* in which they test several possible explanations for an observed phenomenon in a systematic manner. As an example, consider the pendulum problem in the following exercise.

CRITIQUING PIAGET'S THEORY

Perhaps Piaget's greatest contribution to our understanding of cognitive development was the nature of the *questions* he asked and tried to answer about how children think and reason. In addition, some of his key ideas have stood the test of time, including his ideas that children construct their own knowledge about the world, that they must relate new experiences to what they already know, and that encountering puzzling phenomena can sometimes spur them to revise their understandings.

Piaget's descriptions of processes that *propel* development—especially assimilation, accommodation, and equilibration—can be frustratingly vague, however (M. Chapman, 1988; diSessa, 2006; Klahr, 2001). And interaction with one's physical environment, although certainly valuable, may be less critical than Piaget believed. For instance, children with significant physical disabilities, who can't actively experiment with physical objects, learn a great deal about the world simply by observing what happens around them (Bebko, Burke, Craven, & Sarlo, 1992; Brainerd, 2003).

A SECOND LOOK AT PIAGET'S STAGES

Piaget's proposal that cognitive development progresses in stages has sparked a great deal of follow-up research. In general, this research supports Piaget's proposed *sequence* in which different abilities emerge but not necessarily the *ages* at which they emerge. Piaget probably underestimated the thinking capabilities of preschoolers and elementary school students. For example, under some circumstances preschoolers are capable of class inclusion and conservation, and they have some ability to comprehend abstract and contrary-to-fact ideas (S. R. Beck, Robinson, Carroll, & Apperly, 2006; Goswami & Pauen, 2005; McNeil & Uttal, 2009; Rosser, 1994). Many first and second graders can understand and use simple proportions (e.g., $^1/_2$, $^1/_3$, $^1/_4$) if they can relate the proportions to everyday objects and situations (Empson, 1999; Van Dooren, De Bock, Hessels, Janssens, & Verschaffel, 2005). And some older elementary school children can separate and control variables if a task is simplified in some way (Lorch et al., 2010; Metz, 1995; Ruffman, Perner, Olson, & Doherty, 1993).

Yet Piaget seems to have *over*estimated what adolescents can do. Formal operational thinking processes emerge more gradually than he suggested, and even high school students and adults don't necessarily use them regularly (Flieller, 1999; Kuhn & Franklin, 2006; Morra et al., 2008; Tourniaire & Pulos, 1985). Many adolescents seem to better understand abstract ideas when those ideas are accompanied by concrete examples and materials (Blair & Schwartz, 2012; Kaminski & Sloutsky, 2012). Furthermore, students may demonstrate formal operational thought in one content domain while thinking concretely in another (Lovell, 1979; Tamburrini, 1982).

Explicit training and other structured experiences can sometimes help children acquire reasoning abilities sooner than Piaget thought was possible (Brainerd, 2003; Kuhn, 2006). For example, children as young as age 4 or 5 begin to show conservation after having experience with conservation tasks, especially if they can actively manipulate the task materials and discuss their reasoning with someone who already exhibits conservation (Halford & Andrews, 2006; Siegler & Chen, 2008; Siegler & Lin, 2010). Similarly, instruction with concrete or graphic materials can help children and adolescents better understand how to work with fractions and other proportions (Fujimura, 2001; Jitendra, Star, Rodrigues, Lindell, & Someki, 2011; Sarama & Clements, 2009). And in the upper elementary grades, children become increasingly able to separate and control variables when they have many experiences that require them to do so, and they can more easily solve logical problems involving hypothetical ideas if they're taught

relevant problem-solving strategies (Kuhn & Pease, 2008; S. Lee, 1985; Lorch et al., 2014; Schauble, 1990).

In light of such evidence, most researchers believe that the logical thinking abilities Piaget described emerge in gradual, trend-like ways rather than in discrete stages. Nevertheless, as you'll see shortly, some theorists have offered stage-based theories that might account for children's logical reasoning in specific skill areas or content domains.

CONSIDERING DIVERSITY FROM THE PERSPECTIVE OF PIAGET'S THEORY

As a researcher working in Switzerland, Piaget conducted his studies with a particular population: Swiss children. However, the course of cognitive development appears to vary somewhat from one cultural group to another, probably because different cultures provide somewhat different experiences. For example, Mexican children who have had considerable experience in hand-weaving complex flower, animal, and geometric designs show preoperational and concrete operational abilities in new weaving problems sooner than do their same-age counterparts in the United States; the difference remains even if the U.S. children are given explicit training in the Mexican weaving techniques (Maynard & Greenfield, 2003). And Mexican children whose families make pottery for a living acquire conservation skills earlier than their peers in other Mexican families, probably because making pottery requires children to make frequent judgments about needed quantities of clay regardless of the clay's shape (Price-Williams, Gordon, & Ramirez, 1969).

FIGURE 2.6 What are some possible reasons that Herb is catching more fish than the others?

Source: Based on image created by Steven Pulos. Adapted with permission.

Formal operational reasoning skills—for example, reasoning about hypothetical ideas and separating and controlling variables—also vary from culture to culture (Flieller, 1999; Norenzayan, Choi, & Peng, 2007; Rogoff, 2003). Mainstream Western culture actively nurtures these skills through formal instruction in such academic content domains as science, mathematics, literature, and social studies. In some other cultures, however, such skills may have little relevance to people's daily lives (M. Cole, 1990; J. G. Miller, 1997; Norenzayan et al., 2007).

Even within a single cultural group, logical reasoning abilities vary considerably from one individual to another, in part as a result of differences in background knowledge about particular topics. For example, adolescents (adults, too) often apply formal operational thought to topics about which they know a great deal yet think concretely about topics with which they're unfamiliar (Girotto & Light, 1993; M. C. Linn, Clement, Pulos, & Sullivan, 1989; Schliemann & Carraher, 1993). As an illustration, in a study by Pulos and Linn (1981), 13-year-olds were shown a picture similar to the one in Figure 2.6 and told, "These four children go fishing every week, and one child, Herb, always catches the most fish. The other children wonder why." If you look at the picture, you can see that Herb differs from the other children in several ways, including his location, the bait he uses, and the length of his fishing rod. Students who had fished a great deal more effectively separated and controlled variables for this situation than they did for the pendulum problem presented earlier, whereas the reverse was true for students with little or no fishing experience.

CONTEMPORARY EXTENSIONS AND APPLICATIONS OF PIAGET'S THEORY

Despite its shortcomings, Piaget's theory has had considerable influence on present-day thinking about cognitive development and classroom practice. A few contemporary *neo-Piagetian* theories integrate elements of Piaget's theory with current theories of thinking and learning. Furthermore,

educators have found many of Piaget's ideas quite useful in instructional settings. We'll examine three of his ideas—his clinical method, his emphasis on the importance of hands-on experiences, and his concept of disequilibrium—in upcoming sections. The Into the Classroom feature "Applying Piaget's Theory" offers additional suggestions for translating Piaget's ideas into classroom practice.

NEO-PIAGETIAN THEORIES

Neo-Piagetian theories echo Piaget's belief that cognitive development depends somewhat on brain maturation. For instance, some neo-Piagetian theorists suggest that a component of the human memory system known as *working memory* is especially important for cognitive development. In particular, working memory is a brain-based mechanism that enables people to temporarily hold and think about a small amount of new information. Children's working memory capacity increases with age, and thus their ability to think about several things at the same time also increases (Case & Mueller, 2001; Fischer & Bidell, 2006; Lautrey, 1993).

Neo-Piagetian theorists reject Piaget's notion that a single series of stages characterizes children's overall cognitive development. However, they speculate that cognitive development in specific content domains—for example, in understanding numbers or spatial relationships—often has a stage-like nature (e.g., Case, 1985; Case & Okamoto, 1996; Fischer & Immordino-Yang, 2002). Children's entry into a particular stage is marked by the acquisition of new abilities, which children practice and gradually master over time. Eventually they integrate these abilities into more complex structures that mark their transition into a subsequent stage. Thus, as is true in Piaget's theory, the stages are *hierarchical*, with each one being constructed out of abilities acquired in the preceding stage.

Even in a particular subject area, however, cognitive development isn't necessarily a single series of stages through which children progress as if they were climbing rungs on a ladder. In some cases development might be better characterized as progression along "multiple strands" of skills that occasionally interconnect, consolidate, or separate in a weblike fashion (Fischer & Daley, 2007; Fischer & Immordino-Yang, 2002). From this perspective, children may acquire more advanced levels of competence in a particular area through any one of several pathways. For instance, as they become increasingly proficient in reading, children may gradually develop various word decoding and reading comprehension skills, and they draw on all of these skills when reading a book. However, the rate at which each skill is mastered varies from one child to the next.

PIAGET'S CLINICAL METHOD AS AN ASSESSMENT TOOL

Earlier in the chapter we considered Piaget's clinical method, in which an adult probes children's thoughts about a particular task or problem through a sequence of individually tailored questions (recall the dialogue with Brian about the wooden beads). By presenting a variety of Piagetian tasks involving either concrete or formal operational thinking skills (e.g., conservation or separation and control of variables) and asking students to explain what they're thinking, we can gain valuable insights into their logical reasoning abilities (e.g., diSessa, 2007). We need not stick to traditional Piagetian reasoning tasks, however. To illustrate, a teacher might present various kinds of maps (e.g., a road map of Ireland, an aerial map of Chicago, a three-dimensional relief map of a mountainous area) and ask students to interpret what they see. Children in the early elementary grades are apt to interpret maps very concretely, perhaps thinking that lines separating states and countries are actually painted on the earth or that an airport symbolized by a small airplane has only one plane. They might also have difficulty with the scale of a map, perhaps thinking that a line can't be a road because "it's not fat enough for two cars to go on" or that a mountain depicted by a bump on a relief map isn't really a mountain because "it's not high enough" (Liben & Myers, 2007, p. 202). Understanding the concept of *scale* in a map requires proportional reasoning—an ability that doesn't fully emerge until after puberty—and thus it's hardly surprising that young children will be confused by it.

HANDS-ON EXPERIENCES

Piaget suggested that exploration of the physical environment should be largely a child-initiated and child-directed effort. Young children can certainly learn a great deal from their informal interactions with sand, water, and other natural substances (Hutt, Tyler, Hutt, & Christopherson, 1989). And in the elementary and secondary school grades, opportunities to manipulate physical objects—or their virtual equivalents on a computer screen—can enhance students' understanding of basic mathematical and scientific concepts (M. C. Brown, McNeil, & Glenberg, 2009; Lorch et al., 2010; Sarama & Clements, 2009; Sherman & Bisanz, 2009).

Researchers are finding, however, that hands-on experiences are typically more effective *when combined with instruction* that helps students draw appropriate conclusions from what they observe (Fujimura, 2001; Hardy, Jonen, Möller, & Stern, 2006; R. E. Mayer, 2004). In the absence of teacher guidance and directive questions, students may draw inferences based solely on what they see and feel—for instance, erroneously concluding that a very small piece of Styrofoam must have no weight whatsoever—and they may fail to separate and control variables in their experimentation (M. C. Brown et al., 2009; Lorch et al., 2014; C. L. Smith, 2007).

CREATING DISEQUILIBRIUM: THE VALUE OF SOCIOCOGNITIVE CONFLICT

In the opening case study, the girls argue about various ways to solve a problem involving the use of a fraction ($^3/_4$) in making apple tarts. When Jeanette offers a seemingly nonproductive idea ("But three-quarters equals three"), Kerri points out her illogical thinking ("But she can't make only three apple tarts!"). As noted earlier, interaction with peers helps children realize that others often view the world differently than they do and that their own ideas aren't always completely logical or accurate. Furthermore, interactions with age-mates that involve wrestling with contradictory viewpoints—interactions that involve **sociocognitive conflict**—create disequilibrium that may spur children to reevaluate and possibly revise their current understandings. Whereas

children may accept an adult's ideas without argument, some may be quite willing to disagree with and challenge the ideas of their peers (D. W. Johnson & Johnson, 2009b; Lampert, Rittenhouse, & Crumbaugh, 1996; M. C. Linn, 2008).

Ultimately, social interaction—not only with peers but also with adults—is probably even more important for children's cognitive development than Piaget realized. Lev Vygotsky's theory, which we turn to now, describes additional ways in which interactions with fellow human beings promote cognitive growth.

MyEdLab **Self-Check 2.3**

MyEdLab **Application Exercise 2.2.** As you watch children in this exercise, look for certain reasoning skills that Piaget described.

Vygotsky's Theory of Cognitive Development

In Piaget's view, children are largely in control of their own cognitive development; for example, they initiate interactions with objects in their environment and develop self-constructed understandings of what they observe. In contrast, an early Russian developmentalist, Lev Vygotsky, believed that the adults in any society intentionally *foster* children's cognitive development in a somewhat systematic manner. Because Vygotsky emphasized the importance of adult instruction and guidance for promoting cognitive development—and more generally because he emphasized the influence of social and cultural factors on children's cognitive growth—his perspective is known as a **sociocultural theory**.

Vygotsky and his students conducted many studies of children's thinking from the 1920s until Vygotsky's early death from tuberculosis in 1934. Instead of determining the kinds of tasks children could successfully perform *on their own* (as Piaget did), Vygotsky often examined the kinds of tasks children could complete *only with adult assistance.* For example, he described two hypothetical children who could, without help, do things that a typical 8-year-old might be able to do. He would give each of the children progressively more difficult tasks and offer a little bit of assistance, perhaps by asking a leading question or suggesting a reasonable first step. With such help, both children could almost invariably tackle more difficult tasks than they could handle on their own. However, the *range* of tasks that the two children could complete with assistance might be quite different, with one child stretching his or her abilities to succeed at typical 12-year-old-level tasks and the other succeeding only with typical 9-year-old-level tasks (Vygotsky, 1934/1986, p. 187).

Western psychologists were largely unfamiliar with Vygotsky's work until the last few decades of the 20th century, when his major writings were translated from Russian into English (e.g., Vygotsky, 1978, 1934/1986, 1997). Although Vygotsky never had the chance to develop his theory fully, his views are clearly evident in many contemporary theorists' discussions of learning and development and have become increasingly influential in guiding teachers' classroom practices.

VYGOTSKY'S BASIC ASSUMPTIONS

Vygotsky acknowledged that biological factors—such as maturational processes in the brain—play a role in cognitive development. Children bring certain characteristics and dispositions to the situations they encounter, and their responses vary accordingly. Furthermore, children's behaviors, which are influenced in part by inherited traits, affect the particular experiences children have (Vygotsky, 1997). However, Vygotsky's primary focus was on the role of children's social and cultural environments in fostering cognitive growth—and especially in fostering those complex mental abilities that are unique to human beings as a species. Following are central ideas and concepts in Vygotsky's theory.

- *Through both informal conversations and formal schooling, adults convey to children the ways in which their culture interprets and responds to the world.* Vygotsky proposed that as adults interact with children, they share the *meanings* they attach to objects, events, and, more generally, human experience. In the process they transform, or *mediate,* the situations

children encounter. Meanings can be conveyed through a variety of mechanisms, including language (spoken words, writing, etc.), mathematical symbols, graphic displays, fine arts, and music.

Informal conversations are one common mechanism through which adults pass along culturally relevant ways of interpreting situations. But even more important is formal education, through which teachers systematically impart the ideas, concepts, and terminology used in various academic disciplines (Vygotsky, 1934/1986). Although Vygotsky, like Piaget, saw value in allowing children to make some discoveries themselves, he also saw value in having adults pass along the discoveries of previous generations (Vygotsky, 1934/1986).

- *Every culture passes along physical and cognitive tools that make daily living more productive and efficient.* Not only do adults teach children specific ways of interpreting experiences but they also pass along specific tools that can help children tackle the various tasks and problems they're apt to face. Some tools, such as scissors, sewing machines, and computers, are physical objects. Others, such as writing systems, maps, and spreadsheets, are partly physical and partly symbolic. Still others, such as the concept of *fraction* and the process of division (recall the opening case study involving fractions of apples), may have little physical basis at all. In Vygotsky's view, acquiring tools that are at least partly symbolic or mental in nature—cognitive tools—greatly enhances growing children's thinking and functioning.
- *Thought and language become increasingly interdependent in the first few years of life.* One very important cognitive tool is language. For us as adults, thought and language are closely interconnected. We often think by using specific words that our language provides. For example, when we think about household pets, our thoughts may contain such words as *dog* and *cat*. In addition, we usually express our thoughts when we converse with others. In other words, we "speak our minds."

  Vygotsky proposed that thought and language are separate functions for infants and young toddlers. In these early years, thinking occurs independently of language, and when language appears, it's first used primarily as a means of communication rather than as a mechanism of thought. But sometime around age 2, thought and language become intertwined: Children begin to express their thoughts when they speak, and they begin to think in words.

When thought and language first merge, children often talk to themselves—a phenomenon known as **self-talk** (you may also see the term *private speech*). Vygotsky suggested that self-talk serves an important function in cognitive development. By talking to themselves, children learn to guide and direct their own behaviors through difficult tasks and complex maneuvers in much the same way that adults have previously guided them. Self-talk eventually evolves into **inner speech**, in which children talk to themselves mentally rather than aloud. They continue to direct themselves verbally through tasks and activities, but others can no longer see and hear them do it (Vygotsky, 1934/1986). In other words, both self-talk and inner speech help children engage in *self-regulation*.

- *Complex mental processes begin as social activities and gradually evolve into internal mental activities that children can use independently*. Vygotsky proposed that many complex thought processes have their roots in social interactions. As children discuss objects, events, tasks, and problems with adults and other knowledgeable individuals, they gradually incorporate into their own thinking the ways in which the people around them talk about and interpret the world, and they begin to use the words, concepts, symbols, and strategies—in essence, the cognitive tools—that are commonly used in their culture.

  The process through which social activities evolve into internal mental activities is called **internalization**. The progression from self-talk to inner speech just described illustrates this process: Over time, children gradually internalize adults' directions so that they are eventually giving *themselves* the directions.

  Not all mental processes emerge as children interact with adults; some instead develop as children interact with peers. For example, children frequently argue with one another

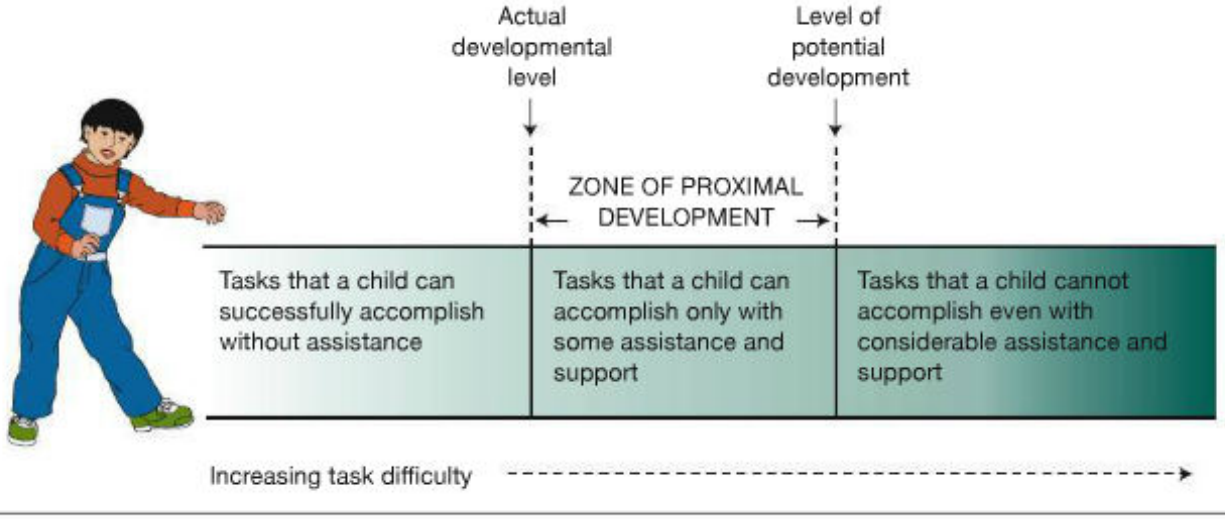
about a variety of matters—how best to carry out an activity, what games to play, who did what to whom, and so on. According to Vygotsky, having arguments helps children discover that there are often several ways to view the same situation. Eventually, he suggested, children internalize the arguing process, developing the ability to look at a situation from a variety of angles *on their own.*

- *Children appropriate their culture's tools in their own idiosyncratic manner.* Children don't necessarily internalize *exactly* what they see and hear in a social context. Rather, they often transform ideas, strategies, and other cognitive tools to suit their own needs and purposes—thus, Vygotsky's theory has a constructivist element to it. The term **appropriation** is often used to refer to this process of internalizing but also adapting the ideas and strategies of one's culture for one's own use.
- *Children can accomplish more difficult tasks when assisted by more advanced and competent individuals.* Vygotsky distinguished between two kinds of abilities that characterize children's skills at any particular point in development. A child's **actual developmental level** is the upper limit of tasks that he or she can perform independently, without help from anyone else. A child's **level of potential development** is the upper limit of tasks that he or she can perform with the assistance of a more competent individual. To get a true sense of children's cognitive development, Vygotsky suggested, we should assess their capabilities not only when performing alone but also when performing with assistance—a strategy that contemporary educators call *dynamic assessment*.

  As mentioned earlier, Vygotsky found that children can typically do more difficult things in collaboration with adults than they can do on their own. For example, they can play more challenging piano pieces when an adult helps them locate some of the notes on the keyboard or provides suggestions about which fingers to use where. They can solve more difficult math problems when their teacher helps them identify critical problem components and potentially fruitful problem-solving strategies. And they can often read more complex prose in a reading group at school than they're likely to read independently at home.
- *Challenging tasks promote maximum cognitive growth.* The range of tasks that children cannot yet perform independently but *can* perform with the help and guidance of others is, in Vygotsky's terminology, the **zone of proximal development (ZPD)** (see Figure 2.7). A child's zone of proximal development includes learning and problem-solving abilities that are just beginning to emerge and develop.

Vygotsky proposed that children learn very little from performing tasks they can already do independently. Instead, they gain new skills primarily by attempting tasks they can accomplish only with assistance and support—that is, when they attempt tasks within their zone of proximal development. Thus, it's the challenges in life, *not* the easy successes, that

FIGURE 2.7 **In Vygotsky's view, tasks in a child's zone of proximal development promote maximal learning and cognitive growth.**



promote cognitive development. But whereas challenging tasks are beneficial, impossible tasks, which children can't do even with considerable structure and guidance, are of no benefit whatsoever (Vygotsky, 1987). For example, it would be pointless to ask most 5-year-olds to solve for *x* in an algebraic equation. In general, a child's ZPD sets a limit on what he or she is cognitively capable of learning.

As teachers, then, we should assign some tasks that students can accomplish successfully *only* with some support. In some instances, this support must come from us or other, more skillful individuals. In other situations, students of equal ability might work together to jointly accomplish difficult assignments—such as the apple-tarts problem in the opening case study—with each student bringing unique strengths to contribute to the overall effort.

Regardless of the nature of the support we provide, we must remember that every student's ZPD will change over time. As some tasks are mastered, other, more complex ones will appear on the horizon to take their place. In addition, students' ZPDs may vary considerably in "width." Some students may, with assistance, be able to stretch several years above their actual (independent) developmental level; others may be able to handle tasks that are only slightly more difficult than what they can currently do on their own. In some instances, students with different zones of proximal development will need individualized tasks and assignments so that they all have challenges that optimally promote their personal cognitive growth.

- *Play allows children to cognitively "stretch" themselves.* One of us authors recalls how, as 5-year-olds, her son Jeff and his friend Scott sometimes played "restaurant." In a corner of Jeff's basement, the boys created a dining area from several child-sized tables and chairs, as well as a restaurant "kitchen" with a toy sink, stove, and supply of plastic dishes and food items. They also created menus, sometimes asking how to spell a word but more often guessing about a word's spelling. On one occasion they invited both sets of parents to "dine," and when the parents arrived, the boys wrote everyone's meal orders on paper tablets and scurried to the kitchen to assemble the requested items. Eventually they returned with the meals (hamburgers, French fries, and cookies—all of them plastic—plus glasses of imaginary milk), which the parents "ate" and "drank" with gusto.

In their restaurant play, the two boys took on several adult roles (restaurant manager, waiter, cook) and practiced a variety of adultlike behaviors. In real life such a scenario would be virtually impossible: Very few 5-year-olds have the cooking, reading, writing, mathematical, or organizational skills necessary to run a restaurant. Yet the element of make-believe brought these tasks within the boys' reach. In Vygotsky's words, "In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself" (Vygotsky, 1978, p. 102).

Furthermore, as children play, their behaviors must conform to certain standards or expectations. In the early elementary school years, children often act in accordance with how a father, teacher, or waiter would behave. In the organized group games and sports that come later, children must follow specific sets of rules. By adhering to such restrictions on their behavior, children learn to plan ahead, to think before they act, and to engage in self-restraint—skills critical for successful participation in the adult world (also see Coplan & Arbeau, 2009; A. Diamond, Barnett, Thomas, & Munro, 2007; Pellegrini, 2009).

Play, then, is hardly a waste of time. Instead, it provides a valuable training ground for the adult world. Perhaps for this reason it's seen in children worldwide.

CRITIQUING VYGOTSKY'S THEORY

Vygotsky focused more on the processes through which children develop than on the characteristics that children of particular ages are likely to exhibit. He described stages of development but portrayed them in only the most general terms (e.g., see Vygotsky, 1997, pp. 214–216). In addition, Vygotsky's descriptions of developmental processes were often vague and speculative (Gauvain, 2001; Haenan, 1996; Moran & John-Steiner, 2003). For such reasons, Vygotsky's theory has been more difficult for researchers to test and either verify or disprove than has the case for Piaget's theory.

Nevertheless, contemporary theorists and educators have found Vygotsky's ideas insightful and helpful. Most significantly, his theory points out the many ways in which *culture* influences cognitive development. A society's culture ensures that each new generation benefits from the accumulating wisdom of preceding generations. Any culture guides children in certain directions by encouraging them to pay attention to particular stimuli (and not to others) and to engage in particular activities (and not in others). In addition, it provides a lens through which children come to view and interpret their experiences in culturally appropriate ways. We see obvious effects of culture in many of children's everyday activities—in the books they read, the roles they enact in pretend play, the extracurricular activities they pursue—but we must remember that culture permeates their unobservable thinking processes as well.

Furthermore, some research has supported Vygotsky's views regarding the progression and role of self-talk and inner speech. The frequency of children's audible self-talk decreases during the preschool and early elementary years, but this decrease is at first accompanied by an increase in whispered mumbling and silent lip movements, presumably reflecting a transition to inner speech (Bivens & Berk, 1990; Winsler & Naglieri, 2003). Self-talk increases when children are performing more challenging tasks, at which they must exert considerable effort to be successful (Berk, 1994; Schimmoeller, 1998). As you undoubtedly know from your own experience, even adults occasionally talk to themselves when they face new challenges!

CONSIDERING DIVERSITY FROM THE PERSPECTIVE OF VYGOTSKY'S THEORY

Vygotsky's theory leads us to expect greater diversity among children—at least in cognitive development—than Piaget's theory does. As we've seen, children in any single age-group are apt to have different zones of proximal development: Tasks that are easy for some children may be quite challenging or virtually impossible for others. In addition, to the extent that specific cultural groups pass along unique concepts, ideas, and beliefs, children from different cultural backgrounds will acquire somewhat different knowledge, skills, and ways of thinking. For instance, children are more likely to acquire map-reading skills if they regularly encounter maps (e.g., of roads, subway systems, and shopping malls) in their community and family life (Liben & Myers, 2007). And children are more apt to have a keen sense of time if cultural activities are tightly regulated by clocks and calendars (K. Nelson, 1996).

CONTEMPORARY EXTENSIONS AND APPLICATIONS OF VYGOTSKY'S THEORY

The Into the Classroom feature "Applying Vygotsky's Theory" presents concrete examples of how teachers might make use of Vygotsky's ideas. In the upcoming sections, we'll consider several ways in which contemporary theorists and educators have built on the foundations that Vygotsky laid.

SOCIAL CONSTRUCTION OF MEANING

Contemporary psychologists have elaborated on Vygotsky's proposal that adults help children attach meanings to the objects and events around them. Often an adult will help a child make sense of the world through a joint discussion of a phenomenon or event they are both experiencing (Feuerstein, Feuerstein, & Falik, 2010; P. K. Murphy, Wilkinson, & Soter, 2011). Such an interaction, sometimes called a mediated learning experience, encourages the child to think about the phenomenon or event in particular ways—to attach labels to it, recognize principles that underlie it, draw certain conclusions from it, and so on. As an example, consider the following exchange, in which a 5-year-old boy and his mother are talking about a prehistoric animal exhibit at a natural history museum.

> ***Boy:*** Cool. Wow, look. Look giant teeth. Mom, look at his giant teeth.
>
> ***Mom:*** He looks like a saber tooth. Do you think he eats meat or plants?
>
> ***Boy:*** Mom, look at his giant little tooth, look at his teeth in his mouth, so big.
>
> ***Mom:*** He looks like a saber tooth, doesn't he. Do you think he eats plants or meat?
>
> ***Boy:*** Ouch, ouch, ouch, ouch. (referring to sharp tooth)
>
> ***Mom:*** Do you think he eats plants or meat?
>
> ***Boy:*** Meat.
>
> ***Mom:*** How come?
>
> ***Boy:*** Because he has sharp teeth. (growling noises) (Ash, 2002, p. 378)

Even without his mother's assistance, the boy would almost certainly have learned something about saber-toothed tigers from his museum visit. Yet Mom helps him make better sense of what he is looking at than he might have done on his own—for instance by using the label *saber tooth* and helping him connect tooth characteristics to eating preferences. Notice how persistent Mom is in asking her son to make the tooth–food connection: She continues to ask him about meat versus plants until the boy finally correctly infers that the tigers must have been meat eaters.

In addition to co-constructing meanings with adults, children and adolescents often talk among themselves to make sense of their experiences. School provides an ideal setting in which young people can toss around ideas and perhaps reach consensus about how best to interpret and understand a complex issue or problem—perhaps about a challenging math problem involving apple tarts, perhaps about troubling interpersonal dynamics with peers, or perhaps about moral dilemmas with no easy right and wrong answers.

Interacting with adults and interacting with peers possibly play somewhat different roles in children's development. Adults usually have more experience and expertise than age-mates do,

and they tend to be more skillful teachers. Accordingly, adults are often the partners of choice when children are trying to master complex new tasks and procedures (Gauvain, 2001; Radziszewska & Rogoff, 1988). Working with peers has a different set of advantages. First, as mentioned in the earlier discussion of Piaget's theory, children who hear age-mates express perspectives quite different from their own may experience sociocognitive conflict that motivates them to overhaul their own understandings. Second, as Vygotsky suggested, peer interactions provide a social context in which children practice and eventually internalize complex cognitive processes, such as effective reading comprehension and argumentation skills (Andriessen, 2006; Chinn, Anderson, & Waggoner, 2001; P. K. Murphy et al., 2011). A third benefit is that children learn valuable social behaviors—including how to plan a joint enterprise and how to coordinate differing roles—when they work on cognitive tasks with their peers (Gauvain, 2001).

SCAFFOLDING

Recall Vygotsky's suggestion that children are most likely to benefit from tasks and activities they can successfully accomplish only with the assistance and support of more competent individuals—that is, tasks within their zone of proximal development. Contemporary theorists have identified a variety of techniques—collectively known as scaffolding—that can help students accomplish challenging tasks in instructional contexts. The following are examples:

- Demonstrate correct performance in a manner that students can easily imitate.
- Divide a complex task into several smaller, simpler activities.
- Provide a structure or set of guidelines for accomplishing the task (e.g., see Figure 2.8).
- Provide a calculator, computer software (word processing program, spreadsheet, etc.), or other technology that makes some aspects of the task easier.
- Keep students' attention focused on critical aspects of the task.
- Ask questions or give hints that encourage students to think about the task in productive ways.
- Give frequent feedback about how students are progressing. (A. Collins, 2006; Gallimore & Tharp, 1990; Rogoff, 1990; van de Pol, Volman, & Beishuizen, 2010; D. Wood, Bruner, & Ross, 1976)

Depending on their particular knowledge and ability levels, different students in any single grade may need different kinds of scaffolding to support their success in a task. As students become more adept at performing a new task, scaffolding is ideally modified to nurture newly emerging skills. And over time the scaffolding is gradually phased out—a process known as *fading*—until students can complete the task entirely on their own. In fact, providing *too much* scaffolding—more than students need—can overwhelm and distract them (van Merriënboer & Sweller, 2005).

GUIDED PARTICIPATION IN CHALLENGING NEW ACTIVITIES

When you were a young child, did you sometimes help a parent or older sibling bake cookies or other goodies? Did the cook let you pour, measure, and mix ingredients when you were old enough to do so? Did the cook also give you directions or suggestions as you performed these tasks? Such experiences are examples of guided participation, in which children gain new skills by working on complex, meaningful tasks in close, scaffolded collaboration with an adult or more experienced peer. As children acquire greater competence, they gradually take a more central role in an activity until, eventually, they're full-fledged participants (Rogoff, 2003; Rogoff et al., 2007). From a Vygotskian perspective, guided participation enables children to engage in behaviors and thinking skills within their zone of proximal development. It also helps children tie newly acquired skills and thinking abilities to the specific contexts in which they're likely to be useful later on.

Guided participation can take many forms in instructional settings. For instance, we might get students involved in scientific investigations, creation of museum displays, or focused Internet searches, while always providing the guidance and support students need to accomplish such tasks successfully. As we engage students in these activities, we might also use some of the language that adults frequently use in such contexts. For example, when conducting scientific investigations with students, we should use such words as *hypothesis*, *evidence*, and *theory* as we go along (Perkins, 1992).

APPRENTICESHIPS

An especially intensive form of guided participation is an apprenticeship, in which a novice works with an expert mentor for a lengthy period to learn how to perform many complex tasks within a particular domain. The expert provides considerable structure and guidance throughout the process, gradually removing scaffolding and giving the novice more independence and responsibility as competence increases (A. Collins, 2006; Rogoff, 1990, 1991). Many cultures use apprenticeships as a means of gradually introducing children to particular skills and trades in the adult community—perhaps weaving, tailoring, or playing a musical instrument (D. J. Elliott, 1995; Lave & Wenger, 1991; Rogoff, 1990).

In a good apprenticeship, a student learns not only how to perform a task but also how to productively *think about* the task—a situation known as a cognitive apprenticeship (J. S. Brown, Collins, & Duguid, 1989; A. Collins, 2006; Dennen & Burner, 2008). For instance, a student might work with a biologist to collect samples of various plants in a certain ecosystem, or a student might work with an experienced carpenter to design and build a kitchen cabinet. In the process of talking about various aspects of the task, the expert and student together analyze the problem at hand and develop the best approach to take, and the expert models effective ways of thinking about and mentally processing the situation.

Apprenticeships differ widely from one context to another, but they typically have some or all of these features (A. Collins, 2006; A. Collins, Brown, & Newman, 1989):

- *Modeling:* The mentor carries out the task, simultaneously thinking aloud about the process, while the learner observes and listens.
- *Coaching:* As the learner performs the task, the mentor gives frequent suggestions, hints, and feedback.
- *Scaffolding:* The mentor provides various forms of support for the learner, perhaps by simplifying the task, breaking it into smaller and more manageable components, or providing less complicated equipment.
- *Articulation:* The learner explains what he or she is doing and why, allowing the mentor to examine the student's knowledge, reasoning, and problem-solving strategies.
- *Reflection:* The mentor asks the learner to compare his or her performance with that of experts, or perhaps with an ideal model of how the task should be done.

- *Increasing complexity and diversity of tasks:* As the learner gains greater proficiency, the mentor presents more complex, challenging, and varied tasks to complete.
- *Exploration:* The mentor encourages the learner to frame questions and problems on his or her own, and in doing so to expand and refine acquired skills.

Because apprenticeships are clearly labor intensive, their use in the classroom isn't always practical or logistically feasible. Even so, we can certainly use elements of an apprenticeship to help students develop more complex skills. For example, we might help students think about writing tasks in the same ways that expert writers do by providing such prompts as "To liven this up, I'll . . ." and "I can tie this together by . . . ." Prompts like these provide the same sort of scaffolding that an expert writer might provide, and they help students develop more sophisticated writing strategies (S. L. Benton, 1997; Scardamalia & Bereiter, 1985; Wong, Hoskyn, Jai, Ellis, & Watson, 2008).

CONTRASTING PIAGET'S AND VYGOTSKY'S THEORIES

Both Piaget and Vygotsky have had a profound influence on contemporary views of learning, thinking, and cognitive development. If we look beyond their differing terminologies, we can see some common themes in the two perspectives. First, both theorists suggested that children acquire increasingly complex thinking processes with age and experience. Second, both argued for the importance of challenge, perhaps in the form of puzzling new information (Piaget's *disequilibrium*) or perhaps in the form of tasks that can be completed only with another person's support (Vygotsky's *zone of proximal development*). And third, at any given point in development children are cognitively ready for some experiences but not for others. In Piaget's view, a child can accommodate to new objects and events only when the child can, to some degree, also assimilate them into existing schemes—that is, there must be some overlap between the "new" and the "old." From Vygotsky's perspective, some challenging new tasks may fall within a child's ZPD—and thus be accomplishable with guidance and support—but other tasks are likely to be out of reach for the time being.

Nevertheless, Piaget's and Vygotsky's theories differ in significant ways. For one thing, Piaget maintained that children's cognitive development is largely the result of their own efforts—for instance, their informal experiments with physical objects and their attempts to restore equilibrium in the face of puzzling events. In contrast, Vygotsky placed considerable emphasis on the role of adults and other, more advanced individuals, who can mediate new experiences and provide needed support during challenging activities. The difference, then, is one of self-exploration and discovery (Piaget) versus guided exploration and instruction (Vygotsky).

A second key difference lies in the potential influence of the culture in which children grow up. Piaget recognized that cultural differences might have an impact, but he didn't systematically explore them in children's thinking processes. In Vygotsky's theory, however, culture is of paramount importance in molding the specific thinking skills children acquire—a perspective that Bronfenbrenner echoed in describing the multiple layers of environmental influence on children's development. Increasingly, contemporary researchers have come to the same conclusion: Children's cultural environments can have a *huge* influence on what children learn and how they develop.

Finally, the two theorists offer differing perspectives on how language enters into the picture. For Piaget, language certainly enhances cognitive development: It provides many labels *(symbols)* that help children mentally represent their world, and it's the primary means through which children gain knowledge of other people's diverse perspectives on various situations and topics. For Vygotsky, on the other hand, language is absolutely essential for cognitive growth. Children's thought processes are internalized versions of social interactions that are largely verbal in nature. Furthermore, in their conversations with adults, children learn the meanings their culture ascribes to particular events and gradually begin to interpret the world in culture-specific ways. In addition, through two language-based phenomena—self-talk and inner speech—children begin to guide their own behaviors in ways that others have previously guided them.

With such benefits in mind, many contemporary theorists share Piaget's and Vygotsky's belief that acquiring language is an important—perhaps the *most* important—factor in cognitive development (e.g., Pinker, 2007; Premack, 2004; Spelke, 2003). We can better understand cognitive development, then, when we also know something about language development.

Language Development

Acquiring the language of one's culture is an extremely complex and challenging undertaking. To understand and use a language effectively, children must master four basic components of the language. First, they must master their language's *phonology*: They must know how words sound and be able to produce the sequence of sounds that make up any given word. Second, they must master *semantics*, the meanings of many thousands of words. Third, they must have a good command of *syntax*, knowing how words can legitimately be combined to form understandable phrases and sentences. And finally, children must master the *pragmatics* of their language—the social conventions and speaking strategies that enable effective communication with others.

Mastering these four components of language is a remarkable achievement for any child, yet before children reach kindergarten, most of them have acquired sufficient proficiency in language to carry on productive conversations with the people around them. Their language development continues throughout childhood and adolescence, in part as a result of informal social interactions and in part as a result of formal instruction (see Table 2.2).

Some aspects of language development during the school years reflect an increasing ability to think abstractly about physical and social phenomena. For example, abstract thought enables children to reflect, deliberately and consciously, on the general nature and functions of language—an acquisition known as metalinguistic awareness (Owens, 2008; Yaden & Templeton, 1986). With such awareness comes an ability to recognize the figurative nature of words—the nonliteral meanings of proverbs, the symbolism in poems and literature, and so on. At the same time, children's ever-expanding language capabilities probably also *help* them think abstractly (K. Nelson, 1996; Pinker, 2007).

Children in the early and middle elementary grades have only limited ability to make sense of figurative language. Here 8-year-old Jeff takes a common expression at face value, rather than recognizing its underlying meaning: that someone has ordered more food than can possibly be eaten.

THEORETICAL ISSUES REGARDING LANGUAGE DEVELOPMENT

Without doubt, children's immediate environments play a significant role in their language development. The richer the language that children hear—that is, the greater the variety of words and the greater the complexity of syntactic structures to which other people expose them—the faster their vocabulary develops (Hoff, 2003; Raikes et al., 2006; Risley & Hart, 2006). Yet children don't simply absorb the language spoken around them. Instead, they appear to use what they hear to construct their own understandings of the language, including knowledge about word meanings, rules governing how words can be combined into sentences, and so on (Cairns, 1996; Cromer, 1987; Karmiloff-Smith, 1993). Thus, we see in language development some of the knowledge *construction* of which Piaget spoke.

Most developmental theorists agree that heredity is also involved in language development to some degree. Human beings have the capacity to acquire a far more complex language than any other species on the planet. Exactly *what* human beings inherit that enables them to learn language is a matter of considerable controversy, however. At a minimum, infants inherit a few key predispositions—for instance, a preference for human voices over other sounds and an ability to hear very subtle differences among speech sounds—that make language learning possible (DeCasper & Fifer, 1980; Jusczyk, 1995; P. K. Kuhl, 2004; J. L. Locke, 1993). In addition, some theorists believe that part of our genetic heritage is a *language acquisition device*, a language-specific learning mechanism that enables infants and toddlers to acquire many intricacies of language in an amazingly short amount of time (Chomsky,

DEVELOPMENTAL TRENDS

TABLE 2.2 • Examples of Linguistic Characteristics and Abilities at Different Grade Levels

GRADE LEVEL	AGE-TYPICAL CHARACTERISTICS	EXAMPLE	SUGGESTED STRATEGIES
 K–2	• Knowledge of 8,000–14,000 words by age 6; understandings of some words only partially correct (e.g., use of the word *animal* may be restricted largely to four-legged mammals) • Difficulty understanding lengthy, complex sentences (e.g., those with multiple clauses) • Superficial understanding of being a "good listener" (e.g., just sitting quietly) • Literal interpretations of messages and requests (e.g., not realizing that "Goodness, this class is noisy" means "Be quiet") • Increasing ability to tell a story, both orally and in writing • Mastery of most sounds; some difficulty pronouncing *r, th, dr, sl,* and *str* • Occasional use of regular word endings (*-s, -ed, -er*) with irregular words (*sheeps, goed, gooder*) • Basic etiquette in conversations (e.g., taking turns, answering questions) • Reluctance to initiate conversations with adults (for many students from Asian and Mexican American backgrounds)	When two police officers visit a first-grade class to talk about how to go to and from school safely each day, the students listen quietly and respectfully. After the visit, however, the students can recall very little about what the officers have told them.	• Read age-appropriate storybooks as a way of enhancing vocabulary. • Give gentle corrective feedback when students' use of words indicates inaccurate understanding. • Work on listening skills (e.g., sitting quietly, paying attention, trying to understand and remember). • Ask follow-up questions to make sure students accurately understand important messages. • Ask students to construct narratives about recent events (e.g., "Tell me about your camping trip last weekend").
 3–5	• Incomplete knowledge of irregular word forms • Correct pronunciation of all sounds in one's language (by age 9 for typically developing children) • Sustained conversations about concrete topics • Increasing ability to take listeners' prior knowledge into account during explanations • Construction of stories with plots and cause-and-effect relationships • Linguistic creativity and word play (e.g., rhymes, word games)	Students in a third-grade class love corny jokes and riddles that involve a play on words. For example, many are amused by "Why did the cookie go to the doctor?" ("He felt crumby") and "Why couldn't the sailors play cards?" ("Because the captain was standing on the deck").	• Teach irregular word forms (e.g., the past tense of *ring* is *rang*, the past tense of *bring* is *brought*). • Consult with a speech-language specialist if articulation problems persist in the upper elementary grades. • Use group discussions as a way to explore academic subject matter. • Have students create short stories that they present orally or in writing. • Encourage jokes and rhymes that capitalize on double meanings and homonyms (i.e., sound-alike words).
 6–8	• Knowledge of about 50,000 words at age 12 • Increasing knowledge of words used in particular academic disciplines (e.g., *ecosystem* in science, *hypotenuse* in mathematics) • Emerging ability to carry on lengthy conversations about abstract topics • Emerging ability to look beyond literal interpretations; comprehension of simple proverbs and increasing ability to detect sarcasm • Increasing metalinguistic awareness; that is, increasing ability to reflect on the underlying nature of language • Increasing proficiency in expository (nonfiction) writing, especially with teacher scaffolding	Students in a sixth-grade class write better persuasive essays when their teacher gives them explicit guidance about elements to include, including (1) an introductory statement expressing one's opinion, (2) supporting evidence for that opinion, (3) reasons why other people might disagree, and (4) explanations of why those reasons are invalid.	• Assign reading materials that introduce new vocabulary. • Introduce some of the terminology used by experts in various content areas (e.g., *simile* in language arts, *molecule* in science). • Conduct structured debates to explore controversial issues. • Ask students to consider the underlying meanings of common proverbs. • Explore the nature of words and language as entities in and of themselves. • Frequently ask students to write about topics; provide guidance about effective writing and frequent feedback about what students have written.

TABLE 2.2 (*Continued*)

GRADE LEVEL	AGE-TYPICAL CHARACTERISTICS	EXAMPLE	SUGGESTED STRATEGIES
 9–12	• Knowledge of about 80,000 words • Acquisition of many vocabulary words related to particular academic disciplines • Subtle refinements in syntax, mostly as a result of formal instruction • General ability to understand figurative language (e.g., metaphors, proverbs, hyperbole) • Significant improvements in expository writing, especially with experience and constructive feedback	When a ninth-grade class reads Robert Frost's poem "The Road Not Taken," most students realize that the poem is only superficially about choosing one of two paths through the woods—that at a deeper level it's about choosing among various paths in life.	• Regularly use the terminologies associated with various academic disciplines. • Distinguish between similar abstract words (e.g., *weather* vs. *climate*, *velocity* vs. *acceleration*). • Explore complex syntactic structures (e.g., multiple embedded clauses). • Consider the underlying meanings and messages in poetry and fiction. • When students have a native dialect other than Standard English, encourage them to use it in informal conversations and creative writing; encourage Standard English for more formal situations.

Sources: Adger, Wolfram, & Christian, 2007; Byrnes, 1996; Capelli, Nakagawa, & Madden, 1990; S. Carey, 1978, 1985; Ferretti, MacArthur, & Dowdy, 2000; C. A. Grant & Gomez, 2001; K. R. Harris, Graham, & Mason, 2006; K. R. Harris, Santangelo, & Graham, 2010; Karmiloff-Smith, 1979; Maratsos, 1998; T. M. McDevitt & Ford, 1987; T. M. McDevitt, Spivey, Sheehan, Lennon, & Story, 1990; Nippold, 1988; O'Grady, 1997; Owens, 2008; Reich, 1986; Stanovich, 2000; Thelen & Smith, 1998.

1972, 2006; M. Gopnik, 1997; Karmiloff-Smith, 1993). Other theorists believe instead that children learn language in much the same way they learn other things about their environment and culture: through detecting and making use of regular patterns of input from their social environment (Gentner & Namy, 2006; Pelucchi, Hay, & Saffran, 2009; Saffran, 2003).

Research evidence does point to a language-specific developmental mechanism for at least *some* aspects of language learning (Lai, Fisher, Hurst, Vargha-Khadem, & Monaco, 2001; Maratsos, 1998; Trout, 2003). Children of all cultures learn language very quickly and acquire complex syntactic structures even when those structures aren't necessary for effective communication. In addition, brain research reveals that certain parts of the left hemisphere seem to be biologically predisposed to specialize in either understanding or producing speech (Aitchison, 1996; J. L. Locke, 1993).

Additional evidence for heredity's influence comes from research findings suggesting that there may be *sensitive periods* in some aspects of language development. Children who have little or no exposure to *any* language in the early years often have trouble acquiring complex language later on, even with intensive language instruction (Curtiss, 1977; Newport, 1990). Furthermore, when learning a *second* language, people have an easier time mastering correct pronunciations, various verb tenses, and complex grammatical structures if they're immersed in the language during childhood or early adolescence (Bialystok, 1994; Bortfeld & Whitehurst, 2001; Bruer, 1999; M. S. C. Thomas & Johnson, 2008). Possibly such sensitive periods reflect biologically built-in time frames for learning language. Alternatively, perhaps what appear to be predetermined "best" times for learning particular aspects of language are simply the result of the brain's tendency to adapt fairly quickly to whatever forms its early auditory environment takes (P. K. Kuhl, 2004; P. K. Kuhl, Conboy, Padden, Nelson, & Pruitt, 2005).

DIVERSITY IN LANGUAGE DEVELOPMENT

Some diversity in language development seems to be the result of biology. For instance, children with a specific language impairment develop normally in all respects except for language. These children have trouble perceiving and mentally processing particular aspects of spoken language—perhaps the quality, pitch, duration, or intensity of specific speech sounds. Often, although not always, the source of the impairment can be traced to heredity or a specific brain abnormality (Bishop, 2006; Bishop, McDonald, Bird, & Hayiou-Thomas, 2009; Corriveau, Pasquini, & Goswami, 2007; Spinath, Price, Dale, & Plomin, 2004).

Cultural factors play a role in linguistic diversity as well. For example, different cultural groups may nurture different *dialects*—distinct forms of a language that characterize particular ethnic groups or geographic regions—and different social conventions for human conversation (i.e., different pragmatic skills) (Adger et al., 2007; Kitayama & Cohen, 2007; Tyler, Uqdah, et al., 2008). Occasionally a cultural or ethnic group specifically nurtures certain aspects of language development. For example, many inner-city African American communities make heavy use of figurative language—such as similes, metaphors, and hyperbole (intentional exaggeration)—in their day-to-day conversations, jokes, and stories (C. D. Lee, 2005; H. L. Smith, 1998; Smitherman, 2007). The following anecdote illustrates this point:

> I once asked my mother, upon her arrival from church, "Mom, was it a good sermon?" To which she replied, "Son, by the time the minister finished preaching, the men were crying and the women had passed out on the floor." (H. L. Smith, 1998, p. 202)

With such a rich oral tradition, it isn't surprising that many inner-city African American youth are especially advanced in their use and understanding of figurative language (Ortony, Turner, & Larson-Shapiro, 1985; H. L. Smith, 1998; Smitherman, 2007).

SECOND-LANGUAGE LEARNING AND ENGLISH LANGUAGE LEARNERS

As mentioned earlier, exposure to a second language in childhood or early adolescence may be especially important for acquiring flawless pronunciation and certain aspects of syntax. Early exposure to a second language seems to be most advantageous if the second language is very different from the first. For example, a native English speaker benefits more from an early start in Arabic or Navajo than from an early start in, say, Spanish or German (Bialystok, 1994; Strozer, 1994). Aside from such caveats, there appears to be no definitive "best" time to begin studying a second language (e.g., P. K. Kuhl et al., 2005; G. Stevens, 2004).

Yet beginning second-language instruction in the early years has other noteworthy advantages. For one thing, it appears that learning a second language facilitates achievement in such other academic areas as reading, vocabulary, and grammar (Diaz, 1983; Reich, 1986). Instruction in a foreign language also sensitizes young children to the international and multicultural nature of the world. Students who learn a second language during the elementary school years express more positive attitudes toward people who speak that language and are more likely to enroll in foreign language classes in high school (Reich, 1986).

BILINGUALISM

At least half of the world's children are *bilingual*—that is, they speak at least two languages fluently (Hoff-Ginsberg, 1997). Although children who grow up in bilingual environments may initially have more limited vocabularies in each language, research reveals clear long-term advantages of bilingualism. Bilingual children appear to have a head start in their development of metalinguistic awareness (Adesope, Lavin, Thompson, & Ungerleider, 2010; Bialystok, 2001). For instance, in the early elementary grades, bilingual children have greater phonological awareness—awareness of the individual sounds, or *phonemes,* that make up spoken words—and this awareness can get them off to an especially good start in learning to read (X. Chen et al., 2004; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Furthermore, when children are truly fluent in both languages, they tend to perform better on tasks requiring focused attention and on tasks requiring flexible, creativity thinking (Adesope et al., 2010; Bialystok, Craik, Green, & Gollan, 2009). Their superior performance on such tasks may be partly the result of enhanced development in certain areas of the brain (Espinosa, 2008; Mechelli et al., 2004).

Being bilingual can have cultural and social advantages as well. In any English-speaking country, mastery of spoken and written English is, of course, essential for long-term educational and professional success. But when a resident of that country belongs to a cultural group that speaks a different language, maintaining social relationships within the culture requires knowledge of its language (McBrien, 2005b). For instance, in many Native American groups, the ancestral language is important for communicating oral history and cultural heritage and for conducting local business (McCarty & Watahomigie, 1998). And Puerto Rican children in the United States often speak Spanish at home as a way of showing respect to their elders (Torres-Guzmán, 1998). Finally, at school, when different students in a single classroom each speak only one of two different languages (perhaps some speaking only English and others speaking only Spanish), teaching students both languages increases student interaction and cross-cultural understanding (A. Doyle, 1982; Padilla, 2006).

TEACHING A SECOND LANGUAGE

Most children in Western, English-speaking countries are exposed to only one language before they reach school age. That single language may or may not be English. School-age children who

are fluent in their native language but not in English are often referred to as English language learners (ELLs). To the extent that elementary and secondary school students have limited knowledge of English, they're apt to have trouble with schoolwork in an English-based classroom (Kieffer, 2008; Padilla, 2006; Slavin & Cheung, 2005; Valdés, Bunch, Snow, & Lee, 2005).

Just as very young children typically learn their native language through informal daily exposure, so, too, can they learn two languages simultaneously if they have frequent, ongoing exposure to both languages. However, when children begin to learn a second language at an older age, perhaps in the elementary grades or even later, they often learn it more quickly if their language-learning experiences are fairly structured (Dixon et al., 2012; Strozer, 1994).

Yet teaching a second language for one 45-minute period a day—as is typically done in high schools—hardly promotes mastery. Two more intensive approaches, immersion and bilingual education, can be quite effective, with each being useful in somewhat different situations. To keep our discussion simple, let's assume that students are living in an English-speaking country. If these students are native English speakers, total immersion in the second language—hearing and speaking it almost exclusively in the classroom during the school day—appears to be the more effective approach. A variation of this approach is a *dual-immersion* program, in which some topics are taught exclusively in English and others are taught exclusively in the second language. For native English speakers living in an English-speaking country, immersion in the second language for part or all of the school day helps students acquire proficiency in the language fairly quickly, and any adverse effects on achievement in other academic areas appear to be short lived (Bialystok et al., 2009; Collier, 1992; Genesee, 1985; Padilla, 2006).

In contrast, English language learners living in an English-speaking country typically fare better in bilingual education, in which they receive intensive instruction in English while studying other academic subject areas in their native language. Not only is their academic achievement at least as good or better in bilingual education, but they also have greater self-esteem and better attitudes toward school (Dixon et al., 2012; Garcia & Jensen, 2009; Marsh, Hau, & Kong, 2002; Tong, Lara-Alecio, Irby, Mathes, & Kwok, 2008; Wright, Taylor, & Macarthur, 2000). The optimal bilingual education program proceeds through a gradual phase-in of English in instruction, perhaps in a sequence such as the following:

1. Students join native-English speakers for classes in subject areas that don't depend too heavily on language skills (e.g., art, music, physical education). They study other subject areas in their native language and also begin classes in English as a second language (ESL).
2. After students have acquired some English proficiency, instruction in English begins for one or two additional subject areas (perhaps math and science).
3. When it's clear that students can learn successfully in English in the subject areas identified in Step 2, they join their English-speaking classmates in regular classes in these subjects.
4. Eventually students are sufficiently proficient in English to join the mainstream in all subject areas, and they may no longer require their ESL classes (Krashen, 1996; Padilla, 2006; Valdés et al., 2005).

Ideally, the transition from instruction in a student's native language to instruction in English occurs very gradually over a period of several years. Simple knowledge of basic conversational English—knowledge collectively known as basic interpersonal communication skills (BICS)—isn't enough for academic success in an English-only curriculum. Ultimately, students must have sufficient mastery of English vocabulary and syntax that they can easily understand and learn from English-based textbooks and lectures; in other words, they must have cognitive academic language proficiency (CALP). Such mastery of English takes considerable time to achieve—often 5 to 7 years (Carhill, Suárez-Orozco, & Páez, 2008; Cummins, 2000, 2008; Dixon et al., 2012; Padilla, 2006).

Why is immersion better for some students whereas bilingual education is better for others? As we've learned, language is an important foundation for cognitive development: Among other things, it provides symbols for mentally representing the world, enables children to exchange ideas with others, and helps them internalize sophisticated cognitive strategies. Students in an English-speaking country who are immersed in a different language at school still have many opportunities—not only at home but also with their friends and in the local community—to continue using and developing their English. In contrast, nonnative English speakers may have few opportunities outside their homes to use their native language. If they're taught exclusively in English, they may very well lose proficiency in their native language before developing adequate proficiency in English—a phenomenon known as subtractive bilingualism—and their cognitive development suffers as a result. Because bilingual education is designed to foster growth in *both* English and a child's native language, it's apt to promote cognitive development as well as English proficiency (Pérez, 1998; Tse, 2001; Winsler, Díaz, Espinosa, & Rodriguez, 1999).

We must remember that students' native languages are very much a part of their sense of identity—their sense of who they are as people (Nieto, 1995; Tatum, 1997). A high school student named Marisol made the point this way:

> I'm proud of [being Puerto Rican]. I guess I speak Spanish whenever I can. . . . I used to have a lot of problems with one of my teachers 'cause she didn't want us to talk Spanish in class and I thought that was like an insult to us, you know? (Nieto, 1995, p. 127)

Incorporating children's cultural backgrounds as well as their native language into the classroom curriculum can further promote their academic success (Igoa, 1995, 2007; U.S. Department of

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Lecture Notes for Modules 5 & 6

TEXTBOOK CHAPTER 3: PERSONAL AND SOCIAL DEVELOPMENT

LEARNING OUTCOMES

1 Describe the nature and origins of children's temperaments and personality characteristics, and explain how you might adapt classroom practices to students' diverse personalities.
2 Explain how students' sense of self is apt to influence their behavior and how you can help students develop healthy self-perceptions.
3 Apply your knowledge of peer relationships and social cognition as you identify strategies for promoting productive social skills and addressing student aggression.
4 Describe typical advancements in moral and prosocial development over the course of childhood and adolescence, and identify strategies for promoting moral and prosocial development at school .

Personality Development

All of us have unique qualities that make us different from the people around us. Our distinctive ways of behaving, thinking, and feeling comprise our personalities. For example, whereas Lupita tends to be quiet and well behaved in class, some of her peers are probably noisy and rambunctious. And whereas Lupita is conscientious about completing her work, we might reasonably guess that some of her classmates are easily distracted and must be prodded to stay on task.

Children's personalities are the result of both heredity—especially in the form of inherited temperaments—and environmental factors. As you will see, heredity and environment often interact in their influences.

TEMPERAMENT

A child's temperament is his or her general tendency to respond to and deal with environmental stimuli and events in particular ways. Children seem to have distinct temperaments almost from birth. Researchers have identified many temperamental styles that emerge early in life and are relatively enduring, including general activity level, adaptability, self-control, persistence, adventurousness, outgoingness, shyness, fearfulness, irritability, and distractibility. Most psychologists agree that such temperamental differences are biologically based and have genetic origins, and to some degree the differences persist into adolescence and adulthood (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Keogh, 2003; Rothbart, 2011; A. Thomas & Chess, 1977).

By influencing children's behaviors, inherited temperaments also influence the specific environmental circumstances they experience and so indirectly affect other aspects of personal and social development (N. A. Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Rothbart, 2011; Strelau, 2008). For example, children who are energetic and adventuresome seek out a wider variety of experiences than those who are quiet and restrained. And children who are naturally vivacious and outgoing typically have more opportunities to learn social skills and establish rewarding interpersonal relationships—including good relationships with their teachers—than do children who are subdued and shy.

Furthermore, many temperamental characteristics affect how students engage in and respond to classroom activities and thus indirectly affect their academic achievement (Keogh, 2003; A. J. Martin, Nejad, Colmar, & Liem, 2013; Saudino & Plomin, 2007). For instance, students are more likely to achieve at high levels if they are persistent, reasonably (but not overly) energetic, and able to ignore minor distractions. They can also achieve greater academic success if their behaviors lead to friendly, productive relationships with teachers and peers—people who can bolster their self-confidence and support their efforts to learn. Underlying some of their academic and social success is an aspect of temperament known as effortful control—their general ability to inhibit immediate impulses in order to think and act productively (Rothbart, 2011; Valiente, Lemery-Chalfant, & Swanson, 2010).

ENVIRONMENTAL INFLUENCES ON PERSONALITY DEVELOPMENT

Genetic differences in temperament are only *predispositions* to behave in certain ways, and environmental conditions and experiences point different children with the same predispositions in somewhat different directions. Two key environmental factors influencing personality development are family dynamics and cultural expectations for behavior.

FAMILY DYNAMICS

Many parents and other family caregivers (e.g., grandparents, older siblings) lovingly interact with a new infant and consistently and dependably provide for the infant's physical and psychological needs. When they do such things, a strong, affectionate caregiver–child bond known as attachment typically forms (Ainsworth, Blehar, Waters, & Wall, 1978). Infants who become closely attached to parents or other caregivers early in life are apt to develop into amiable, independent, self-confident children and adolescents who adjust easily to new classroom environments, establish productive relationships with teachers and peers, and have an inner conscience that guides their behavior. In contrast, children who don't become closely attached to a parent or

some other individual early in life can be immature, dependent, unpopular, and prone to disruptive and aggressive behaviors later on (J. P. Allen, Porter, McFarland, McElhaney, & Marsh, 2007; Kochanska, Aksan, Knaack, & Rhines, 2004; Mikulincer & Shaver, 2005; S. Shulman, Elicker, & Sroufe, 1994; Sroufe, Carlson, & Shulman, 1993).

In addition to forming emotional attachments with children, parents and other family caregivers tend to adopt fairly consistent *parenting styles* they use in raising the children. In mainstream Western culture, the best situation for most children seems to be authoritative parenting, which combines affection and respect for children with reasonable restrictions on behavior. Authoritative parents provide a loving and supportive home, hold high expectations and standards for performance, explain why behaviors are or are not acceptable, enforce household rules consistently, include children in decision making, and provide age-appropriate opportunities for autonomy. Children from authoritative homes tend to be happy, energetic, self-confident, and likeable. They make friends easily and show self-control and concern for the rights and needs of others. Children of authoritative parents appear well adjusted, in part, because their behavior fits well with the values espoused by mainstream Western culture. They listen respectfully to others, follow reasonable rules for behavior, work well independently, and strive for academic achievement (Barber, Stolz, & Olsen, 2005; Baumrind, 1989, 1991; Bradley, 2010; M. R. Gray & Steinberg, 1999; J. M. T. Walker & Hoover-Dempsey, 2006). Given such benefits, authoritative parenting can provide a good model for how we, as teachers, should generally conduct our classrooms.

Authoritative parenting isn't universally "best," however. Certain other parenting styles may be better suited to particular cultures and environments. For instance, in authoritarian parenting, parents expect complete and immediate compliance; they neither negotiate expectations nor provide reasons for their requests. In many Asian American and Hispanic families, high demands for obedience are made within the context of close, supportive parent–child relationships. Underlying the message of control is a more important message: "I love you and want you to do well, but it's equally important that you act for the good of the family and community" (X. Chen & Wang, 2010; Halgunseth, Ispa, & Rudy, 2006; Rothbaum & Trommsdorff, 2007). Authoritarian parenting is also more common in impoverished economic environments. When families live in low-income, inner-city neighborhoods where danger potentially lurks around every corner, parents may better serve their children by being strict and directive about activities (Hale-Benson, 1986; McLoyd, 1998).

Some degree of parental guidance and discipline seems to be important for optimal personal and social development. Parents who are overly permissive—for instance, those who let their children come and go as they please and impose few consequences for inappropriate actions—tend to have children who are immature and impulsive, do poorly in school, and act aggressively toward peers (Aunola & Nurmi, 2005; Joussemet et al., 2008; Lamborn, Mounts, Steinberg, & Dornbusch, 1991). Yet we must be careful that we don't point accusatory fingers or in other ways be judgmental about how parents are bringing up their children. Some parents may have learned ineffective parenting strategies from their own parents. Others may have challenges in their lives—perhaps mental illness, marital conflict, or serious financial problems—that hamper their ability to nurture and support their children.

Child maltreatment. In a few unfortunate instances, parents' behaviors toward their children constitute child maltreatment. One form of child maltreatment is child *neglect:* Parents fail to provide nutritious meals, adequate clothing, and other basic necessities of life. In other cases parents or other family members *abuse* children physically, sexually, or emotionally. Possible indicators of neglect or abuse are chronic hunger, lack of warm clothing in cold weather, untreated medical needs, frequent or serious physical injuries (e.g., bruises, burns, broken bones), and exceptional knowledge about sexual matters.

Parental neglect and abuse can have significant adverse effects on children's personal and social development. On average, children who have been routinely neglected or abused have low self-esteem, poorly developed social skills, and low school achievement. Many are angry, aggressive, and defiant. Others can be depressed, anxious, socially withdrawn, and possibly suicidal (Crosson-Tower, 2010; J. Kim & Cicchetti, 2006; Maughan & Cicchetti, 2002; R. A. Thompson & Wyatt, 1999).

Teachers are both legally and morally obligated to report any cases of suspected child abuse or neglect to the proper authorities (e.g., the school principal or child protective services). Two helpful resources are the National Child Abuse Hotline at 1-800-4-A-CHILD (1-800-422-4453) and the website for Childhelp at www.childhelp.org.

CULTURAL EXPECTATIONS AND SOCIALIZATION

As we've seen, various cultural groups influence children's personalities indirectly through the parenting styles they encourage. Culture also has a more direct influence on children's personal and social development through a process known as socialization. That is, members of a cultural group work hard to help growing children adopt the behaviors and beliefs that the group holds dear. Children typically learn their earliest lessons about their culture's expectations for behavior from parents and other family members, who teach them simple manners (e.g., saying please and thank you), encourage them to do well in school, and so on (W.-B. Chen & Gregory, 2008; Eccles, 2007). Once children reach school age, teachers become equally important socialization agents. For example, in mainstream Western society, teachers typically expect and encourage such behaviors as showing respect for authority figures, following rules and directions, controlling impulses, working independently, and asking for help when it's needed (Manning & Baruth, 2009; Wentzel & Looney, 2007). Cultures around the globe encourage many of these behaviors, but they don't necessarily endorse *all* of them. For instance, many children of Mexican heritage are more accustomed to observing events quietly and unobtrusively—as Lupita does in the opening case study—than to asking adults for explanations and help (Correa-Chávez, Rogoff, & Mejía Arauz, 2005; Gutiérrez & Rogoff, 2003).

Researchers have observed other cultural differences in socialization practices as well. For example, many European American families encourage children to think for themselves and be assertive in expressing their needs and opinions, but families from many other countries (e.g., Mexico, China, India) are more likely to encourage restraint, obedience, and deference to elders (Goodnow, 1992; Joshi & MacLean, 1994; Morelli & Rothbaum, 2007). And whereas many American children are encouraged to be outgoing and emotionally expressive, children in many Asian cultures are encouraged to be shy and emotionally reserved (X. Chen, Chung, & Hsiao, 2009; Huntsinger & Jose, 2006; Morelli & Rothbaum, 2007). However, considerable diversity exists *within* any culture, with different parents, teachers, and other adults encouraging somewhat different behaviors and beliefs.

When behaviors expected of students at school differ from those expected at home or when belief systems presented by teachers are inconsistent with those of children's parents, children may initially experience some culture shock. At a minimum, these children are apt to be confused and distracted, at least in the first few days or weeks of school. Some children with less adaptable or more irritable temperaments may even become angry or resistant (Rothbart, 2011; C. Ward, Bochner, & Furnham, 2001).

As teachers, we must certainly encourage behaviors essential for students' long-term success, such as obeying rules, following instructions, and working independently. At the same time, students will need our guidance, support, and patience when our expectations differ from those of their family or cultural group.

THE "BIG FIVE" PERSONALITY TRAITS

As children grow older, the many interactions among their inherited temperaments and environmental circumstances lead to unique and somewhat stable personality profiles. Research with both children and adults has yielded five general personality traits that are relatively independent of one another and appear to involve somewhat different areas of the brain. You can remember them using the mnemonic *OCEAN:*

- *Openness:* The extent to which one is curious about the world and receptive to new experiences and ideas
- *Conscientiousness:* The extent to which one is careful, organized, self-disciplined, and likely to follow through on plans and commitments
- *Extraversion:* The extent to which one is socially outgoing and seeks excitement
- *Agreeableness:* The extent to which one is pleasant, kind, and cooperative in social situations
- *Neuroticism:* The extent to which one is prone to negative emotions (e.g., anxiety, anger, depression) (Caspi, 1998; DeYoung et al., 2010; A. J. Martin et al., 2013; G. Matthews, Zeidner, & Roberts, 2006)

TEMPERAMENT, PERSONALITY, AND GOODNESS OF FIT

On average, students who are conscientious about their work and open to new experiences achieve at higher levels at school (Hattie, 2009; A. J. Martin et al., 2013; M. C. O'Connor & Paunonen, 2007). Yet there is no single best temperament or personality that maximizes students' adjustment and achievement in the classroom. Instead, children are more likely to succeed at school when there is a goodness of fit—rather than a mismatch—between their natural inclinations and typical behaviors, on the one hand, and classroom activities and expectations, on the other (A. Thomas & Chess, 1977). For example, when teachers want students to participate actively in whole-class discussions, highly energetic, outgoing children are apt to shine, but quieter students (like Lupita) might feel anxious or intimidated. When teachers require a lot of independent seatwork, quieter children often do well, but some energetic children may be viewed as disruptive (Keogh, 2003; Rothbart, 2011).

As teachers, we must keep in mind that students' distinctive ways of behaving in the classroom—their energy levels, sociability, impulsiveness, and the like—aren't entirely within their control. The Creating a Productive Classroom Environment feature "Accommodating Students' Diverse Temperaments and Personality Traits" offers several suggestions for adapting instruction and classroom management strategies to accommodate students' individual behavioral styles.

Development of a Sense of Self

With their increasing capacity for symbolic thinking and (eventually) abstract reasoning, growing children begin to draw conclusions about who they are as people. As an example, try the following exercise.

EXPERIENCING FIRSTHAND
DESCRIBING YOURSELF

List at least 10 words or phrases that describe you as a person.

How did you describe yourself? Are you smart? Friendly? Open-minded? Physically attractive? Moody? Your answers provide a window into a key component of your personality known as **sense of self**—your perceptions, beliefs, judgments, and feelings about who you are as a person. Many psychologists distinguish between two aspects of the sense of self: *self-concept*—assessments of one's own characteristics, strengths, and weaknesses—and *self-esteem*—judgments and feelings about one's own value and worth. These two aspects closely overlap, however, and thus the two terms are often used interchangeably (Bracken, 2009; Byrne, 2002; McInerney, Marsh, & Craven, 2008).

In overall self-assessments, young children tend to make distinctions between two general domains: how competent they are at day-to-day tasks (including schoolwork) and how much their family and friends like them. As they grow older, children make finer and finer distinctions—for instance, they realize that they may be more or less competent or "good" in various academic subjects, athletic activities, peer relationships, and physical attractiveness (Arens, Yeung, Craven, & Hasselhorn, 2011; Davis-Kean & Sandler, 2001; Harter, 1999). Each of these domains may have a greater or lesser influence on students' overall sense of self. For some students, academic achievement may be the overriding factor, whereas for others, physical attractiveness or popularity with peers may be more important (Crocker & Knight, 2005; D. Hart, 1988; Harter, 1999).

Children and adolescents tend to behave in ways that mirror their beliefs about themselves (M. S. Caldwell, Rudolph, Troop-Gordon, & Kim, 2004; Marsh & O'Mara, 2008; Valentine, DuBois, & Cooper, 2004). For instance, if they see themselves as good students, they're more likely to pay attention, follow directions, persist at difficult problems, and enroll in challenging courses. If they see themselves as friendly and socially desirable, they're more likely to seek the company of their classmates and perhaps run for student council. If they see themselves as physically skillful, they'll more eagerly pursue extracurricular athletics.

Students' beliefs about themselves are, like their beliefs about the world around them, largely self-constructed. Accordingly, their self-assessments may or may not be accurate. When students evaluate themselves fairly accurately, they're in a good position to choose age-appropriate tasks and activities (Baumeister, Campbell, Krueger, & Vohs, 2003; Harter, 1999). A slightly inflated self-assessment can be beneficial as well, because it encourages students to work toward challenging yet potentially reachable goals (Bjorklund & Green, 1992; Pajares, 2009). However, a sense of self that is *too* inflated can give some students an unwarranted sense of superiority over classmates and lead them to bully or in other ways act aggressively toward peers (Baumeister et al., 2003; Baumeister, Smart, & Boden, 1996; Menon et al., 2007). And as you might guess, students who significantly *under*estimate their abilities are apt to avoid the many challenges that would enhance their cognitive and social growth (Schunk & Pajares, 2004; Zimmerman & Moylan, 2009).

FACTORS INFLUENCING SENSE OF SELF

Students often gain initial insights about their general competence in a certain domain from their *own successes and failures* in that domain (Chiu, 2012; Marsh & O'Mara, 2008). For instance, they may discover that they can easily solve—or, instead, consistently struggle with—simple math problems. Or they may find that they can run faster—or more slowly—than most of their peers. Through such experiences, students acquire a sense of self-efficacy about the degree to which they can succeed in certain activities and accomplish certain goals. Over time, students' specific self-efficacies for various tasks and activities contribute to their more general sense of self (Bong & Skaalvik, 2003; McInerney et al., 2008).

Unfortunately, an interplay between self-perceptions and behaviors can create a vicious cycle: A poor sense of self leads to less productive behaviors, which leads to fewer successes, which perpetuates the poor sense of self. However, simply telling students that they're good or smart or in some other way "special" is unlikely to break the cycle (Brummelman, Thomaes, Orobio de Castro, Overbeek, & Bushman, 2014; McMillan, Singh, & Simonetta, 1994; Pajares, 2009). Instead, we must make sure that students have many opportunities to improve and eventually succeed at academic, social, and physical tasks—not obviously easy tasks (which presumably anyone could do) but challenging ones that reflect a genuine sense of accomplishment. When we present such challenges, we must, of course, be sure that students have the prerequisite knowledge and scaffolding they need to be successful (Bouchey & Harter, 2005; Dunning, Heath, & Suls, 2004; Leary, 1999).

Yet students' personal successes and failures aren't the only things affecting their sense of self. A second important factor is students' social context—and more specifically, *other people's behaviors*—which influences their self-perceptions in at least two ways. For one thing, how students evaluate themselves depends to some extent on how their own performance compares to that of their peers. For example, students who see themselves achieving at higher levels than classmates are apt to develop a more positive sense of self than those who consistently find themselves falling short (R. Butler, 2008; Liem, Marsh, Martin, McInerney, & Yeung, 2013; Trautwein, Gerlach, & Lüdtke, 2008). Thus, peer comparisons can dampen high-ability students' sense of self when they attend classes made up largely of students with similarly high ability (Chiu, 2012; Seaton, Marsh, & Craven, 2010).

In addition, students' self-perceptions are affected by how others behave *toward* them. Peers often communicate information about children's social and athletic competence, perhaps by seeking out a child's companionship or ridiculing a child in front of others (M. S. Caldwell et al., 2004; Crosnoe, 2011; Rudolph, Caldwell, & Conley, 2005). Adults, too, influence children's sense

of self, in part by the kinds of expectations they hold for children's performance and in part by drawing attention to various things children do well or poorly (M. J. Harris & Rosenthal, 1985; O'Mara, Marsh, Craven, & Debus, 2006; Pajares, 2009). As teachers, we should, of course, communicate realistically high expectations for achievement and give positive feedback about the specific things students do well. And when we find that we must give students negative feedback—and occasionally we must—we should do so while also communicating optimism about their future performance. For instance, we might point out that mistakes are a natural part of the learning process, and we should offer concrete suggestions about how to improve.

A third general factor that can impact students' sense of self is *membership in a successful group* (Harter, 1999; Thorkildsen, Golant, & Cambray-Engstrom, 2008; Wigfield, Eccles, & Pintrich, 1996). If you think back to your own school years, perhaps you can recall taking pride in something your entire class accomplished or feeling good about a community service project completed through an extracurricular club. School groups aren't the only groups affecting students' sense of self. For instance, some cultures encourage children to take pride in the accomplishments of their families as well as—or perhaps instead of—their own accomplishments (Banks & Banks, 1995; P. M. Cole & Tan, 2007). And as we'll see a bit later in the chapter, students' membership in certain ethnic groups can also be a source of pride.

DEVELOPMENTAL CHANGES IN SENSE OF SELF

We've already seen one way in which self-perceptions change with age: Children increasingly differentiate among the many aspects of who they are as people—their academic abilities, physical qualities, social relationships, and so on. But children's and adolescents' beliefs and feelings about themselves change in other ways as well. One early personality theorist, Erik Erikson, proposed that people's personalities and sense of self continue to evolve throughout the life span in a predictable sequence of *psychosocial stages,* described in Figure 3.1. However, our focus in the upcoming sections will be on what more contemporary researchers have learned about developmental changes in children's and adolescents' sense of self.

Childhood Elementary school children tend to think of themselves in terms of concrete, easily observable characteristics and behaviors, such as their age, sex, and favorite activities (D. Hart, 1988; Harter, 1983). In racially and culturally diverse communities, where different skin colors, languages, and customs are obvious, children may also classify themselves as belonging to one or another racial or ethnic group (Phinney, 1990; Sheets, 1999). For instance, when she was in second grade, 7-year-old Tina drew the self-portrait shown in Figure 3.2. As a girl with a Native American and Hispanic genetic heritage, she was clearly aware that her hair and skin tone were darker than those of most of her classmates.

Most young children have a generally positive sense of self. Sometimes they believe they're more capable than they really *are* and that they can easily overcome initial failures (R. Butler, 2008; Lockhart, Chang, & Story, 2002; Robins & Trzesniewski, 2005). As children have more opportunities to compare themselves with peers during the elementary grades and as they become cognitively more able to *make* such comparisons, their self-assessments become increasingly realistic (R. Butler, 2008; J. W. Chapman, Tunmer, & Prochnow, 2000; Davis-Kean et al., 2008). They also begin to pull together their many self-observations into generalizations about the kinds of people they are—perhaps friendly, good at sports, smart, or dumb—and such generalizations lead to the development of increasingly stable self-concepts (D. A. Cole et al., 2001; Harter, 1999).

Early adolescence As students reach adolescence and gain greater capability for abstract thought, they increasingly think of themselves in terms of general, fairly stable traits. Consider 12-year-old Tina's self-description in sixth grade:

> I'm cool. I'm awesome. I'm way cool. I'm 12. I'm boy crazy. I go to Brentwood Middle School. I'm popular with my fans. I play viola. My best friend is Lindsay. I have a gerbil named Taj. I'm adopted. I'm beautiful.

Although Tina listed a few concrete features, she had clearly developed a fairly abstract self-perception. Her focus on coolness, popularity, and beauty, rather than on intelligence or academic achievement (or, we might add, modesty), is fairly typical: Social acceptance and physical appearance are far more important to many young adolescents than academic competence (D. Hart, 1988; Harter, 1999).

Students' self-concepts and self-esteem often drop as they make the transition from elementary school to middle school or junior high, with the drop being more pronounced for girls (D. A. Cole et al., 2001; Harter, 1999; Robins & Trzesniewski, 2005). The physiological changes accompanying puberty may be a factor: Many boys and girls think of themselves as being somewhat less attractive once they reach adolescence (S. Moore & Rosenthal, 2006; Stice, 2003). Changes in the

FIGURE 3.1 Erikson's eight stages of psychosocial development

Overview of Erikson's Stages

Erik Erikson (1963, 1972) proposed that people proceed through eight distinct stages over the course of their lives. Each stage presents a unique developmental task, and how a person addresses it influences her or his general mental health and progress through later stages.

Trust versus mistrust (infancy). According to Erikson, the major developmental task in infancy is to learn whether other people, especially primary caregivers, regularly satisfy basic needs. If caregivers are consistent sources of food and comfort, an infant learns *trust*—that others are dependable and reliable. If caregivers are neglectful or abusive, the infant learns *mistrust*—that the world is an undependable, unpredictable, and possibly dangerous place.

Autonomy versus shame and doubt (toddler years). As toddlers gain increasing muscular control, they begin to satisfy some of their own needs—for example, by feeding and dressing themselves. If caregivers encourage self-sufficient behavior, toddlers develop a sense of *autonomy*—a sense of being able to handle many problems on their own. but if caregivers demand too much too soon or, in contrast, restrict or ridicule early attempts at self-sufficiency, children may instead develop *shame and doubt* about their abilities.

Initiative versus guilt (preschool years). With their growing independence, preschoolers have many choices about the activities they pursue. If parents and preschool teachers encourage and support children's efforts while also helping them make realistic and appropriate choices, children develop *initiative*—independence in planning and undertaking activities. but if, instead, adults discourage the pursuit of independent activities or else dismiss them as silly and bothersome, children develop *guilt* about their needs and desires.

Industry versus inferiority (elementary school years). Elementary school provides many opportunities for children to achieve the recognition of teachers, parents, and peers by producing things—drawing pictures, writing short stories, and so on. If children are encouraged to make and do things and then praised for their accomplishments, they begin to demonstrate *industry* in that they diligently pursue and persist at certain tasks and often put work before pleasure. If they are instead punished for their efforts or if they find they are incapable of meeting others' expectations, they develop a sense of *inferiority* about their capabilities.

Identity versus role confusion (adolescence). Adolescents begin to ponder the roles they might play in the adult world. Initially, they're apt to experience some *role confusion*—mixed ideas and feelings about the specific ways in which they will fit into society—and may experiment with a variety of behaviors and activities (e.g., tinkering with cars, babysitting for neighbors, affiliating with certain religious groups). Erikson proposed that eventually most adolescents achieve a sense of *identity* regarding who they are and where their lives are headed.

Intimacy versus isolation (young adulthood). In Erikson's view, once young people have established their identities, they're ready to make long-term social commitments. Many become capable of *intimacy*, forming one or more reciprocal relationships that involve compromise and self-sacrifice. People who can't form intimate relationships—perhaps because they have trouble putting aside their own needs—develop a sense of *isolation*.

Generativity versus stagnation (middle age). During middle age the primary developmental task is one of contributing to society and helping to guide future generations. When a person makes a contribution during this period, he or she feels a sense of *generativity*—a sense of productivity and accomplishment. In contrast, a person who is self-centered and unable or unwilling to help society move forward develops a feeling of *stagnation*—a dissatisfaction with his or her relative lack of productivity.

Integrity versus despair (retirement years). As people reach retirement, they look back on their lives and accomplishments. If they believe that they've led a happy, productive life, they gain feelings of contentment and *integrity*. But if they look back on a life of disappointments and unachieved goals, they may develop a sense of *despair*.

Critiquing Erikson's Theory

Erikson's theory reminds us that development is a life-long process: Children and adults alike have new things to learn and new challenges to meet. At the same time, his theory has shortcomings. First, Erikson drew his ideas largely from personal anecdotes rather than systematic research (Crain, 2005). Second, he based his stages primarily on work with men; for many women, a focus on intimacy emerges either before or in conjunction with a focus on identity (Josselson, 1988). And third, Erikson didn't take into account the important role that culture plays in development. Many cultures intentionally discourage autonomy, initiative, and self-assertiveness in young children, sometimes as a way of protecting children from the very real dangers of their environments (X. Chen et al., 2009; Harwood, Miller, & Irizarry, 1995; G. J. Powell, 1983).

As teachers, we should keep in mind that the age ranges for accomplishing Erikson's eight developmental tasks are probably broader than Erikson proposed. For instance, most people probably don't achieve a sense of identity as early or as easily as Erikson suggested (see the discussion of identity in the section "Late Adolescence"). Nevertheless, the first five stages have implications for us as teachers, who must work hard to do the following:

- Help students overcome early difficulties with trust, autonomy, or initiative—in particular, by being reliable sources of affection and support (trust) and by giving students age-appropriate opportunities to work independently (autonomy) and undertake self-chosen activities (initiative).
- Promote a sense of industry by engaging students in meaningful tasks and completing worthwhile projects.
- Help adolescents in their search for identity by providing opportunities to explore various roles they might play in adult society.

FIGURE 3.2 As early as the primary grades, students in racially diverse communities have some awareness of their membership in a particular racial group. Notice how 7-year-old Tina portrays herself as having darker hair and skin than the classmates behind her.

school environment—including disrupted friendships, more superficial teacher–student relationships, and more rigorous academic standards—probably also have a negative impact.

Also with early adolescence come two new phenomena with implications for sense of self. First, students become more cognitively able to reflect on how others might see them (Harter, 1999). They may initially go to extremes, thinking that in any social situation everyone else's attention is focused squarely on them—a phenomenon known as the imaginary audience (Elkind, 1981; R. M. Ryan & Kuczkowski, 1994; Somerville, 2013). Because they believe themselves to be the center of attention, young teenagers (especially girls) are often preoccupied with their physical appearance and can be quite self-critical. To some degree, this heightened concern about what other people might think of them appears to be linked to maturational changes in certain areas of the brain, including areas that underlie self-focused emotions such as shame and embarrassment (Somerville et al., 2013).

A second noteworthy phenomenon in early adolescence is emergence of the personal fable: Young teenagers often believe they are completely unlike anyone else (Elkind, 1981; Lapsley, 1993). For instance, they may think that no one else—and certainly not a parent and teacher—has ever experienced the intensity of emotions they feel about thwarted goals or unhappy love affairs. Furthermore, some have a sense of invulnerability and immortality, believing themselves immune to the normal dangers of life. Thus they may take foolish risks, such as experimenting with drugs and alcohol, having unprotected sexual intercourse, and driving at high speeds (DeRidder, 1993; Dodge et al., 2009; Galván, 2012; Nell, 2002). It's important to note, however, that adolescents are apt to take risks even when they *don't* believe themselves to be invulnerable, for reasons you can discover in the Applying Brain Research feature "Understanding and Addressing Adolescent Risk Taking."

Late adolescence The majority of older adolescents recover sufficiently from the double whammy of puberty and a changing school social environment to enjoy positive self-concepts and overall mental health (Harter, 1999; S. I. Powers, Hauser, & Kilner, 1989). The imaginary audience and personal fable phenomena slowly decline, although remnants remain throughout the high school years.

Older teenagers increasingly reflect on their own characteristics and abilities and begin to struggle with seeming inconsistencies in their self-perceptions, as one ninth grader explained:

> I really don't understand how I can switch so fast from being cheerful with my friends, then coming home and feeling anxious, and then getting frustrated and sarcastic with my parents. Which one is the *real* me? (Harter, 1999, p. 67)

Eventually, perhaps around 11th grade, most students integrate their various self-perceptions into a complex, multifaceted sense of self that reconciles apparent contradictions—for instance, recognizing that their inconsistent behaviors on different occasions mean that they're "flexible" (Harter, 1999).

As older adolescents pull the numerous parts of themselves together, many of them begin to form a general sense of identity: a self-constructed definition of who they are, what things they find important, and what goals they want to accomplish in life. In their ongoing search for a long-term identity, adolescents may initially take on temporary identities, aligning themselves with a particular peer group, insisting on a certain mode of dress, or continually changing self-descriptions and photos on Facebook, Instagram, and other social media (Alemán & Vartman, 2009; Greenhow, Robelia, & Hughes, 2009; Seaton, Scottham, & Sellers, 2006). Adolescents may also have somewhat different identities in different contexts, depending on the traditional roles they have played in each context (Eccles, 2009; Greeno, 2006; Vadeboncoeur, Vellos, & Goessling, 2011). For example, a student might be a "loser" at school but a "star" in an out-of-school activity or a "leader" in a neighborhood gang.

Erik Erikson proposed that most people achieve an overall sense of identity by the end of adolescence (see Figure 3.1). In contrast, many contemporary developmental theorists believe that identity formation continues to be a work-in-progress well into adulthood, especially as people move into new and different life circumstances (Bandura, 2008; Sinai, Kaplan, & Flum, 2012; Vadeboncoeur et al., 2011). Marcia (1980, 1991) has described four distinct patterns of behavior that may characterize the status of a young person's search for identity:

- *Identity diffusion.* The individual has made no commitment to a particular career path or ideological belief system. Some haphazard experimentation with particular roles or beliefs may have taken place, but the individual hasn't yet embarked on a serious exploration of issues related to self-definition.
- *Foreclosure.* The individual has made a firm commitment to an occupation, a particular set of beliefs, or both. The choices have been based largely on what others (especially parents) have prescribed, without an earnest exploration of other possibilities.
- *Moratorium.* The individual has no strong commitment to a particular career or set of beliefs but is actively exploring and considering a variety of professions and ideologies. In essence, the individual is undergoing an identity crisis.
- *Identity achievement.* After going through a period of moratorium, the individual has emerged with a clear choice of occupation, a commitment to particular political or religious beliefs, or both.

For most young people, the ideal situation seems to be to proceed through a period of moratorium and exploration—a period that may continue well into adulthood—and to eventually settle on a clear identity that can flexibly evolve as life circumstances change (A. Kaplan & Flum, 2012; Luyckx et al., 2008; Sinai et al., 2012).

Table 3.1 presents developmental changes in children's and adolescents' sense of self and offers suggestions for how, as teachers, we can enhance their self-perceptions at different grade levels.

DIVERSITY IN SENSE OF SELF

As you undoubtedly know from your own experiences, students differ considerably in their self-esteem and overall sense of self. Sometimes such differences are indirectly the result of biology. For instance, students who are physically attractive tend to have more positive self-concepts than students with less appealing physical features (Harter, Whitesell, & Junkin, 1998). And on average, students with cognitive, social, or physical disabilities have lower self-esteem than their classmates (T. Bryan, 1991; Marsh & Craven, 1997; Martinez & Huberty, 2010).

DEVELOPMENTAL TRENDS

TABLE 3.1 • Sense of Self at Different Grade Levels

GRADE LEVEL	AGE-TYPICAL CHARACTERISTICS	EXAMPLE	SUGGESTED STRATEGIES
 K–2	• Self-descriptions largely limited to concrete, easily observable characteristics • Some tendency to overestimate abilities and chances of future success, especially in domains in which one has little or no prior experience	When 6-year-old Jeff is asked to describe himself, he says, "I like animals. I like making things. I do good in school. I'm happy. Blue eyes, yellow hair, light skin." He mentions nothing about his shyness, sense of humor, and ability to work and play independently—characteristics that would require considerable self-reflection and abstract thought to identify.	• Encourage students to stretch their abilities by tackling the challenging tasks they think they can accomplish. • Provide sufficient scaffolding to make success possible in various domains. • Praise students for the things they do well; be specific about the behaviors you're praising.
 3–5	• Increasing awareness of and differentiation among particular strengths and weaknesses • Association of such emotions as pride and shame with various self-perceptions	When Kellen begins fifth grade at his neighborhood middle school, his classwork rapidly deteriorates, despite individualized instruction in reading and spelling. At home one day, his mother finds him curled in a ball under his desk, crying and saying, "I can't do this anymore!" Alarmed, Mom takes him to a series of specialists, who diagnose severe dyslexia. Kellen's parents eventually find a school that provides considerable structure and scaffolding for students with learning disabilities. There Kellen shows dramatic improvement in virtually every area of the curriculum, and his self-esteem skyrockets.	• Focus students' attention on their improvement over time. • Encourage pride in individual and group achievements, but be aware that students from some ethnic groups may prefer that recognition be given only for group achievements. • Provide opportunities for students to look at one another's work only when *everyone* has something to be proud of.

 6–8	• Increasingly abstract self-conceptions • For many, a decline in self-esteem after the transition to middle or junior high school (especially for girls) • Heightened concern about others' perceptions and judgments of oneself (imaginary audience) • Excessive belief in one's own uniqueness, sometimes accompanied by risk taking and a sense of invulnerability to normal dangers (personal fable)	Meghan describes a recent event in her eighth-grade algebra class: "I had to cough but I knew if I did everyone would stare at me and think I was stupid, hacking away. So I held my breath until I turned red and tears ran down my face and finally I coughed anyway and everyone *really* noticed then. It was horrible."	• After students make the transition to middle school or junior high, be especially supportive and optimistic about their abilities and potential for success. • Minimize opportunities for students to compare their own performance unfavorably with that of others. • Be patient when students show exceptional self-consciousness; give them strategies for presenting themselves well to others.
 9–12	• Search for the "real me" and an adult identity; experimentation with a variety of possible identities • Increasing integration of diverse self-perceptions into an overall, multifaceted sense of self • Gradual increase in self-esteem • Continuing risk-taking behavior (especially for boys)	Sixteen-year-old Kayla often revises her profile on Facebook—for instance, modifying the "Details About You" section—and regularly changes the photo that appears at the top of her profile. Sometimes she displays a happy Kayla, at other times a more sullen one; an early photo shows her in her basketball uniform, but a later one shows her in a skimpy party dress.	• Give students opportunities to examine and try out a variety of adultlike roles. • Encourage students to explore and take pride in their cultural and ethnic heritages. • When discussing the potential consequences of risky behaviors, present the facts but don't make students so anxious or upset that they can't effectively learn and remember the information (e.g., avoid scare tactics).

Sources: Bracken, 2009; R. Butler, 2008; Davis-Kean et al., 2008; Dweck, 2000; Elkind, 1981; Figner & Weber, 2011; Greenhow, Robelia, & Hughes, 2009; Harter, 1999; Liem, Marsh, Martin, McInerney, & Yeung, 2013; Lockhart et al., 2002; Marcia, 1980, 1991; T. M. McDevitt & Ormrod, 2007 (Kellen example); Nell, 2002; Nuemi, 2008; O'Mara et al., 2006; Orenstein, 1994, p. 47 (Meghan example); Pajares, 2009; Robins & Trzesniewski, 2005; Seaton et al., 2006; Sinai, Kaplan, & Flum, 2012; Somerville et al., 2013; Spear, 2007; Tatum, 1997; Whitesell et al., 2006.

Gender differences. For most young people, their gender is a core ingredient in their sense of self and can become increasingly prominent during puberty. Thus, many children and adolescents prefer to engage in behaviors and activities that are stereotypically "appropriate" for their gender. For example, to the extent that boys believe that getting good grades at school is something that "girls do," they may have little interest in classroom activities and assignments (Elmore & Oyserman, 2012).

Some researchers have found gender differences in overall self-esteem, with boys rating themselves more highly than girls, especially in adolescence. Many students' self-perceptions tend to be consistent with stereotypes about what males and females are supposedly "good at." For instance, even when actual ability levels are the same, boys tend to rate themselves more highly in math and sports, and girls tend to rate themselves more highly in language and literacy (Bracken, 2009; D. A. Cole et al., 2001; Herbert & Stipek, 2005; Joët, Usher, & Bressoux, 2011).

Cultural and ethnic differences. In many Native American communities and many Middle Eastern and Far Eastern countries, children and adolescents see their group membership and connections with other individuals as central parts of who they are as human beings (Kağitçibaşi, 2007; M. Ross & Wang, 2010; Whitesell, Mitchell, Kaufman, Spicer, & the Voices of Indian Teens Project Team, 2006). In addition, many young people have a strong ethnic identity: They're both aware and proud of their ethnic group and willingly adopt some of the group's behaviors. Occasionally students' ethnic identities can lead them to reject mainstream Western values. In some ethnic minority groups, peers may accuse high-achieving students of "acting White," a label that essentially means "You're not one of us" (Bergin & Cooks, 2008; Cross, Strauss, & Fhagen-Smith, 1999; Ogbu, 2008a). For the most part, however, students with a strong and positive ethnic identity do *well* in school both academically and socially (Altschul, Oyserman, & Bybee, 2006; Hamm, Hoffman, & Farmer, 2012; Smokowski, Buchanan, & Bacalleo, 2009). Furthermore, pride in one's ethnic heritage and high academic achievement can serve as an emotional buffer against other people's prejudicial insults and discrimination (L. Allen & Aber, 2006; P. J. Cook & Ludwig, 2008; DuBois, Burk-Braxton, Swenson, Tevendale, & Hardesty, 2002).

Not all students from minority groups affiliate strongly with their cultural and ethnic groups. Some students—especially those with multiple racial or cultural heritages—fluctuate in the strength of their ethnic identity depending on the context and situation (Hitlin, Brown, & Elder, 2006; Y.-Y. Hong, Wan, No, & Chiu, 2007; Yip & Fuligni, 2002). In addition, older adolescents may experiment with varying forms of an ethnic identity. Some teens, for instance, may initially adopt a fairly intense, inflexible, and perhaps hostile ethnic identify before eventually retreating to a more relaxed, open-minded, and productive one (Cross et al., 1999; Nasir, McLaughlin, & Jones, 2009; Seaton et al., 2006).

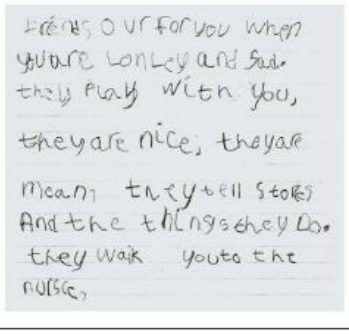
Development of Peer Relationships and Interpersonal Understandings

For many students, interacting with and gaining the acceptance of peers—in some way *fitting in*—are more important than classroom learning and achievement (Crosnoe, 2011; Dowson & McInerney, 2001; LaFontana & Cillessen, 2010). Yet social success and academic success aren't an either-or situation. In fact, students who enjoy good relationships with their peers at school are *more* likely to achieve at high levels (Gest, Domitrovich, & Welsh, 2005; Patrick, Anderman, & Ryan, 2002; Pellegrini & Bohn, 2005).

ROLES OF PEERS IN CHILDREN'S DEVELOPMENT

Peer relationships, especially friendships, serve at least four functions in children's and adolescents' personal and social development. First, they provide an arena for learning and practicing a variety of social skills, including cooperation, negotiation, emotional control, and conflict resolution (J. P. Allen & Antonishak, 2008; Granic, Lobel, & Engels, 2014; Larson & Brown, 2007). Second, young people can help one another with schoolwork and teach one another valued physical and cognitive skills—say, in skateboarding or computer programming—in which parents and other local adults have little or no expertise (Barron, 2006; Hickey, 2011; Ladd, Kochenderger-Ladd, Visconti, & Ettekal, 2012).

FIGURE 3.3 **In this writing sample, 7-year-old Andrew describes the many benefits of having friends.**



In addition, peers provide companionship, safety, and emotional support, as illustrated in Figure 3.3. They become a group with whom to eat lunch, a safe haven from playground bullies, and shoulders to cry on in times of trouble or confusion (Jordan, 2006; Laursen, Bukowski, Aunola, & Nurmi, 2007; Wentzel, 2009). Many adolescents (especially girls) reveal their innermost thoughts and feelings to their friends (Levitt, Guacci-Franco, & Levitt, 1993; Patrick et al., 2002; A. J. Rose et al., 2012). Friends often understand a teenager's perspectives—for instance, a preoccupation with physical appearance and concerns about the opposite sex—when others are seemingly clueless.

Peers play a fourth important role in personal and social development as well: They serve as socialization agents who both directly and indirectly encourage certain ways of behaving (M. H. Jones, Audley-Piotrowski, & Kiefer, 2012; A. M. Ryan, 2000; Wentzel & Watkins, 2011). Peers define options for leisure time, perhaps forming study groups, playing video games, or smoking cigarettes behind the school building. They serve as role models and provide standards for acceptable behavior, showing what's possible, what's admirable, what's cool. And they sanction one another for stepping beyond acceptable bounds, perhaps through ridicule, gossip, or ostracism. Traditionally such influences have been known as *peer pressure,* but many of them are better described as peer contagion, in which certain behaviors "spread" from one child or adolescent to another through a variety of means (B. B. Brown, Bakken, Ameringer, & Mahon, 2008; Sandstrom, 2011).

Much of the pressure to conform to other people's standards and expectations actually comes from within rather than from outside. In particular, most children and adolescents engage in self-socialization, putting pressure on *themselves* to adopt the behaviors they think others will find acceptable (B. B. Brown, 1990; Bukowski, Velasquez, & Brendgen, 2008; Crosnoe, 2011; Juvonen, 2006). Such self-pressure tends to be strongest in early adolescence; as an example, 12-year-old Mariel explains what happened when, in fifth grade, students from two different elementary schools transitioned to the same middle school:

> When you get to middle school the other school comes in, you're like, "Oh no, what if they don't like me?" So you try to be cool and stuff. But you never seem to get there. They're always one step ahead of you.

A common misconception is that peer influences are invariably a bad thing, but in fact they're a mixed bag. Many peers encourage such desirable qualities as working hard in school, treating people kindly, and engaging in community service. Others, however, encourage cutting class, bullying certain students, consuming alcohol or drugs, or in other ways behaving in counterproductive ways (Altermatt, 2012; Mayeux, Houser, & Dyches, 2011; Prinstein & Dodge, 2008; Spinrad & Eisenberg, 2009; Wentzel & Watkins, 2011).

Although peers' behaviors and values certainly have an impact, their effects have probably been overrated. Most children and adolescents acquire a strong set of values and behavioral standards from their families, and they don't necessarily abandon these values and standards in the company of peers (B. B. Brown, 1990; W. A. Collins et al., 2000; Galambos, Barker, & Almeida, 2003). Furthermore, they tend to choose friends who are similar to themselves in academic achievement, leisure-time activities, and long-term goals (Kindermann, 2007; Prinstein & Dodge, 2008; A. M. Ryan, 2001). In some cases, they may lead "double lives" that enable them to attain academic success while maintaining peer acceptance (Grimes, 2002; Hemmings, 2004; Juvonen, 2006; Mac Iver, Reuman, & Main, 1995). For example, although they attend class and faithfully do homework, they may feign disinterest in scholarly activities, disrupt class with jokes or goofy behaviors, and express surprise at receiving high grades. In addition, they may act tough when they're in public, saving their softer sides for more private circumstances, as one sixth grader's reflection reveals:

> You'd still have to have your bad attitude. You have to act—it's just like a movie. You have to act. And then at home you're a regular kind of guy, you don't act mean or nothing. But when you're around your friends you have to be sharp and stuff like that, like push everybody around. (Juvonen & Cadigan, 2002, p. 282)

Young adolescents often work hard to look cool in the eyes of their peers, as this drawing by 11-year-old Marci illustrates.

It's important to keep in mind that self-socialization involves adopting behaviors that a child or adolescent *believes* to be critical for gaining favor with important peers. For example, many students think that their peers will look down on them for working hard at school, achieving at high levels, and in other ways being "smart," when in fact their peers may secretly admire such behaviors (Hamm et al., 2012). And in any case, as the brain continues to mature in late adolescence, especially in the relatively "rational" prefrontal cortex, the concern about pleasing peers seems to dissipate a bit (Albert, Chein, & Steinberg, 2013).

As teachers, we can help students maintain a good public image in a variety of ways. For instance, we can help them acquire skills for presenting themselves in a favorable light—perhaps by teaching public-speaking techniques, nurturing artistic talents, or tactfully suggesting personal hygiene strategies. We can assign small-group projects in which every student has a unique talent to contribute. And when valued classmates ridicule academic achievement, we can allow students to demonstrate their accomplishments privately (e.g., through written assignments or one-on-one conversations) instead of in front of classmates.

Help students look good in the eyes of their peers.

COMMON SOCIAL GROUPS IN CHILDHOOD AND ADOLESCENCE

Researchers have distinguished among a variety of social groups in young people's lives, including friendships, cliques, crowds, subcultures, gangs, and romantic relations.

FRIENDSHIPS

Close friends find activities that are mutually meaningful and enjoyable, and over time they acquire a common set of experiences that enable them to share certain perspectives on life (Gottman, 1986; Suttles, 1970). Because friends typically have an emotional investment in their relationship, they work hard to look at situations from one another's point of view and to resolve disputes that threaten to separate them. As a result, they develop increased perspective-taking and conflict resolution skills. Close, supportive friendships also foster self-esteem and a general sense of well-being (Basinger, Gibbs, & Fuller, 1995; Berndt, 1992; Bukowski, Motzoi, & Meyer, 2009; Newcomb & Bagwell, 1995).

CLIQUES, CROWDS, AND SUBCULTURES

With age and experience, many students form larger social groups that frequently get together. In early adolescence, cliques—moderately stable friendship groups of perhaps 3 to 10 individuals—provide the setting for most voluntary social interactions. Clique boundaries tend to be fairly rigid and exclusive—some people are "in," whereas others are "out"—and memberships in various cliques often affect students' social status (B. B. Brown, 2011; Crockett, Losoff, & Peterson, 1984; Goodwin, 2006; Kindermann, McCollam, & Gibson, 1996). Here is 14-year-old Courtney's description of an especially exclusive "popular" clique in her eighth-grade class:

> There are table groups at lunch. My group gave them all names. The popular ones, we call them the Sardines. They are in their little box, they don't let anyone into their box, they're so close together. You'll never see one of them by themselves. Like one of them's a TV and the other ones are like little remotes following her.

Crowds are considerably larger than cliques and don't have the tight-knit cohesiveness and carefully drawn boundaries of cliques. Their members tend to share certain characteristics and

behaviors (e.g., "brains" study a lot, "jocks" are active in sports), attitudes about academic achievement, and (occasionally) ethnic background (B. B. Brown, 2011; Steinberg, 1996). Crowd membership may or may not be a voluntary thing; for instance, membership in a so-called "popular" crowd is apt to be based as much on a student's reputation as on his or her actual efforts to affiliate with certain peers (B. B. Brown et al., 2008; Juvonen & Galván, 2008).

Occasionally a crowd takes the form of a subculture—a group that resists a powerful dominant culture by adopting a significantly different lifestyle (J. S. Epstein, 1998). Some subcultures are relatively benign; for example, as one of us authors knows well, some young teens may consistently wear baggy pants, address peers as "dude," and spend a good deal of their time mastering new tricks on their skateboards. Other subcultures are worrisome, such as those that endorse racist and anti-Semitic behaviors (e.g., skinheads) and those that practice Satanic worship and rituals. Adolescents are more likely to affiliate with troublesome subcultures when they feel alienated from the dominant culture—perhaps that of their school or that of society more generally—and want to distinguish themselves from it in some way (Crosnoe, 2011; J. R. Harris, 1998).

In the upper high school grades, a greater capacity for abstract thought allows many adolescents to think of other people more as unique individuals and less as members of stereotypical categories. They may also discover characteristics they have in common with peers from diverse backgrounds. Perhaps as a result of such changes, ties to specific social groups tend to dissipate, hostilities between groups soften, and students become more open-minded in their friendship choices (B. B. Brown, Eicher, & Petrie, 1986; Gavin & Fuhrman, 1989; Shrum & Cheek, 1987).

GANGS

A gang is a cohesive social group characterized by initiation rites, distinctive colors and symbols, "ownership" of a specific territory, and feuds with one or more rival groups. Typically, gangs are governed by strict rules for behavior and stiff penalties for violations. Young people affiliate with gangs for a variety of reasons. Some do so as a way of demonstrating loyalty to their family, friends, or neighborhood. Some seek the status and prestige that gang membership brings. Some have poor academic records and perceive gang activity as an alternative means of gaining recognition for accomplishments. Many members of gangs have troubled relationships with their families or have been consistently rejected by peers, and so they turn to gangs to get the emotional support they can find nowhere else (Dishion, Piehler, & Myers, 2008; Kodluboy, 2004; Petersen, 2004; Simons, Whitbeck, Conger, & Conger, 1991).

As teachers, we can definitely make a difference in the lives of any gang members in our classes (S. G. Freedman, 1990; Parks, 1995). We must, first and foremost, show these students that we truly care about them and their well-being. For instance, we can be willing listeners in times of trouble and can provide the support that gang members need to achieve both academic and social success. We must also have some knowledge of students' backgrounds—such as their family dynamics, economic circumstances, and cultural upbringings—so that we can better understand the issues with which they may be dealing. And we must certainly work cooperatively and proactively with our colleagues to minimize violent gang activity at school.

sion and violence at school.

ROMANTIC RELATIONSHIPS

As early as the primary grades, children talk of having boyfriends or girlfriends, and the opposite sex is a subject of interest throughout the elementary school years. With the onset of adolescence, the biological changes of puberty bring on new and sometimes unsettling feelings and sexual desires. Not surprisingly, then, romance is a frequent topic of conversation in the middle and high school grades. Middle school students' romances tend to exist more in their minds than in reality; for example, two students might be identified as "going out" even if they never actually date. Young adolescents' romantic thoughts may also involve crushes on people who are out of reach—perhaps favorite teachers or movie stars (B. B. Brown, 1999; Eckert, 1989; B. C. Miller & Benson, 1999).

For many children, thoughts of romance emerge early, as 5-year-old Isabelle's artwork illustrates.

Eventually many adolescents begin to date, especially if their friends are dating. Early choices in dating partners are often based on physical attractiveness or social status, and dates may involve only limited and superficial interaction (B. B. Brown, 2011; Furman, Brown, & Feiring, 1999; Pellegrini, 2002). As adolescents move into the high school grades, some form more intense, affectionate, and long-term relationships with members of the opposite sex, and these relationships often (but by no means always) lead to sexual intimacy (J. Connolly & McIsaac, 2009; Furman & Collins, 2009).

From a developmental standpoint, romantic relationships have definite benefits: They can address young people's needs for companionship, affection, and security, and they provide an opportunity to experiment with new social skills and interpersonal behaviors (Davila, 2008; Furman & Simon, 2008; B. C. Miller & Benson, 1999). At the same time, romance can wreak havoc with adolescents' emotions. Adolescents have more extreme mood swings than younger children or adults, and for many this instability may be partly due to the excitement and frustration of being romantically involved or *not* involved (Davila, 2008; Furman & Collins, 2009; Larson, Clore, & Wood, 1999).

As students reach high school (occasionally earlier), a significant minority of them find themselves attracted to their own sex either instead of or in addition to the opposite sex. Adolescence can be a particularly confusing time for gay, lesbian, and bisexual individuals. Some struggle to make sense of their sexual orientation and may experience considerable depression. Yet many others enjoy good mental health, especially if their home and school environments communicate acceptance of diverse sexual orientations (Darwich, Hymel, & Waterhouse, 2012; Espelage, Aragon, Birkett, & Koenig, 2008; Savin-Williams, 2008).

The extent to which we, as teachers, talk about sexuality with our students must be dictated, in part, by school policies and the values of the community in which we work. At the same time, especially if we're teaching at the middle school or high school level, we must be aware that romantic and sexual relationships—whether real or imagined—are a considerable source of excitement, frustration, confusion, and distraction for students, and we must lend a sympathetic ear and an open mind to those students who seek our counsel and support.

POPULARITY AND SOCIAL ISOLATION

When the daughter of one of us authors was in junior high school, she sometimes said, "No one likes the popular kids." As self-contradictory as her remark might have been—and Mom always told her that it was—it's consistent with research findings. When students are asked to identify their most "popular" classmates, they identify peers who have dominant social status at school (perhaps those who belong to a prestigious social group) but in many cases are aggressive or stuck-up (Cillessen, Schwartz, & Mayeux, 2011; W. E. Ellis & Zarbatany, 2007; Hawley, 2014). For example, when 14-year-old Courtney was asked what the popular kids were like, she had this to say:

> Nobody likes the popular kids. We all think they're bratty, they're mean. The only reason they're popular is because they'll make out with guys at the back of the bus. . . . They don't include anyone. They have their own parties that consist only of themselves. They can't branch out.

Yet contrary to Courtney's description, *truly* popular students—those whom many classmates select as people they'd like to do things with—may or may not hold high-status positions, but they're kind, trustworthy, and socially skillful, as Lupita is in the opening case study. They also tend to show genuine concern for others—for instance, by sharing, cooperating, and empathizing with peers (Asher & McDonald, 2009; Cillessen & van den Berg, 2012; Mayeux et al., 2011).

In contrast to popular students, rejected students are those whom classmates select as being the *least* preferred social companions. Students with few social skills—for example, those who are impulsive or aggressive—typically experience peer rejection (Asher & McDonald, 2009; Pedersen, Vitaro, Barker, & Borge, 2007; Rubin, Cheah, & Menzer, 2010). Students who are noticeably overweight and those who appear to be gay or lesbian are also frequent targets of ridicule, harassment, and rejection, as are some members of racial and ethnic minority groups (Graham & Hudley, 2005; Swearer, Espelage, Vaillancourt, & Hymel, 2010). Peer rejection over a lengthy period—psychologists call it *social marginalization*—can cause students considerable psychological distress and shame. To cope with such feelings and try to preserve a positive sense of self, these students may psychologically disengage from school life, jeopardizing their academic achievement as well as their social development and emotional well-being. Some of them begin to associate with other marginalized peers, who may or may not encourage attitudes and behaviors that will be productive over the long run (Bellmore, 2011; Ladd et al., 2012; Loose, Régner, Morin, & Dumas, 2012).

Members of a third group, controversial students, elicit diverse reactions, in that some peers really like them and others really *dis*like them. These students can, like some rejected students, be quite aggressive, but they also have good social skills that make them popular with at least some of their peers (Asher & McDonald, 2009; Cillessen & van den Berg, 2012; Mayeux et al., 2011). Many students whom classmates refer to as "popular" actually fall into this category.

Researchers have described a fourth category as well. Neglected students are those whom peers rarely choose as someone they would either most like or least like to do something with (Asher & Renshaw, 1981). Some of these seemingly overlooked students prefer to be alone, others are quite shy or don't know how to go about initiating interaction, and still others are content with having only one or two close friends (Gazelle & Ladd, 2003; Guay, Boivin, & Hodges, 1999; McElhaney, Antonishak, & Allen, 2008). Occasionally "neglected" status is a temporary situation, but some students are friendless and socially marginalized for extended periods—such is often the case for recent immigrants and for students with disabilities—and these students are at higher-than-average risk for depression (Gazelle & Ladd, 2003; Igoa, 2007; Yuker, 1988).

Especially in the middle school and high school grades, most students are well aware of which peers do and don't have high social status, and some of them do things that aren't in their own or others' best interests—for instance, engaging in substance abuse or casual sexual intimacy—in an effort to gain or maintain membership in an allegedly "popular" group (Cillessen et al., 2011; Crosnoe, 2011). For example, they may ridicule and bully peers whom they perceive to be odd or nerdy. And they may abruptly abandon friendships that could undermine their image of "coolness," as 14-year-old Courtney revealed when describing something that happened in a close-knit group of five girls:

> The five of us would hang out, sit at the same lunch table. Then Jamie became good friends with another group. They had parties, became the popular group, so Jamie left us. She had been Maggie's best friend, so Maggie was devastated. Jamie wouldn't talk to us, wouldn't even wave at us in the hallway.

Not all status-seeking students successfully climb to the top of the social hierarchy, of course, and their failure to do so can leave them feeling isolated, depressed, and uninterested in school achievement (Cillessen et al., 2011; Crosnoe, 2011; Somerville, 2013).

One way that, as teachers, we might discourage counterproductive status-seeking behaviors is to act as *myth busters,* explicitly opening up conversations about what true popularity involves. For example, we might begin by having students think of a few peers they genuinely like and then of a few peers they really *don't* like. These mental lists must remain only in students' own heads—*no names should be mentioned*—but by asking students to reflect on such questions as "What characteristics do people on your first list have in common?" and "Why don't you like the people on your second list?," qualities such as "kind" and "trustworthy" (for the first list) and "stuck-up" and "mean" (for the second list) might come to light.

We can also help offset the hard feelings that peer rejection or neglect may engender by being especially warm and attentive with socially isolated students (Crosnoe, 2011; Wentzel, 1999). In fact, when *we* show that we like particular students, their classmates are more likely to accept and act positively toward them as well (L. Chang, 2003; L. Chang et al., 2004). We can also assist with interpersonal skills. Because of their social isolation, rejected and neglected students have fewer opportunities to develop the social skills that many of them desperately need (Coie & Cillessen, 1993; McElhaney et al., 2008; Vitaro, Boivin, Brendgen, Girard, & Dionne, 2012).

SOCIAL COGNITION

To be effective in interpersonal relationships, students must engage in social cognition: They must consider how people around them are likely to think about, behave in, and react to various situations. Those who think regularly about other people's thoughts and feelings tend to be socially skillful and make friends easily (Bosacki, 2000; P. L. Harris, 2006; Izard et al., 2001). Some psychologists propose that social cognition is a distinct human ability—which they call *emotional intelligence*—whereas others believe that it's simply an integral part of people's general intellectual and social functioning (J. D. Mayer, Salovey, & Caruso, 2008; Waterhouse, 2006; Zeidner,

Roberts, & Matthews, 2002). In any case, certain structures in the brain do seem to be dedicated to it (Spunt & Lieberman, 2013).

PERSPECTIVE TAKING

One important element of social cognition is perspective taking, looking at the world from other people's viewpoints. The following situation provides an example.

EXPERIENCING FIRSTHAND

LAST PICKED

Consider this scenario:

> Kenny and Mark are co-captains of the soccer team. They have one person left to choose for the team. Without saying anything, Mark winks at Kenny and looks at Tom, who is one of the remaining children left to be chosen for the team. Mark looks back at Kenny and smiles. Kenny nods and chooses Tom to be on their team. Tom sees Mark and Kenny winking and smiling at each other. Tom, who is usually one of the last to be picked for team sports, wonders why Kenny wants him to be on his team. . . .
>
> - Why did Mark smile at Kenny?
> - Why did Kenny nod?
> - Why did Kenny choose Tom to be on the team? How do you know this?
> - Do you think that Tom has any idea of why Kenny chose him to be on the team? How do you know this? . . .
> - How do you think Tom feels? (Bosacki, 2000, p. 711)

To answer these questions, you must look at the situation from the perspectives of the three boys involved. For instance, if you put yourself in Tom's shoes, you might suspect that he has mixed feelings. If he enjoys soccer, he may be happy to have a chance to play, but he may also be wondering whether the other boys' nonverbal signals indicate a malicious intention to make him look foolish on the soccer field. And, of course, Tom may feel embarrassed or demoralized at consistently being one of the last children picked for a team. (Accordingly, asking some students to select classmates for team games is generally *not* recommended.)

Recent brain research indicates that, to some degree, human beings may be "prewired" to look at situations from other people's perspectives as well as their own. In particular, certain neurons in the brain, known as mirror neurons, fire either when a person is performing a particular behavior *or* when the person watches *someone else* perform that behavior. Some of these mirror neurons are involved both in feeling certain emotions—perhaps disgust or anguish—and in observing such emotions in others' facial expressions (Gallese, Gernsbacher, Heyes, Hickok, & Iacoboni, 2011; Rizzolatti & Sinigaglia, 2008).

Yet truly effective perspective taking also involves active, conscious thinking and learning about human beings' general mental and psychological states. As children grow older, most develop and increasingly refine a theory of mind—a self-constructed understanding of their own and others' thoughts, beliefs, feelings, and motives. The development of a theory of mind appears to involve the prefrontal cortex of the brain—a part of the brain that continues to mature over the course of childhood and adolescence (Liu, Sabbagh, Gehring, & Wellman, 2009; Steinberg, 2009).

Probably as a result of both experience and brain maturation, children gain an increasingly complex understanding of human thought processes and feelings as they grow older, enabling them to become increasingly effective in interacting with others.

Childhood. Consistent with what we know about cognitive development, young children tend to focus on other people's concrete, observable characteristics and behaviors (e.g., look once again at Andrew's essay in Figure 3.3). However, they do have some awareness of other people's inner worlds. As early as age 4 or 5, they realize that what *they* know may be different from what *other people* know (Wellman, Cross, & Watson, 2001; Wimmer & Perner, 1983). They also have some ability to make inferences about other people's mental and emotional states—for instance, to deduce that people who behave in certain ways have certain intentions or feelings (P. L. Harris,

2006; Schult, 2002; Wellman, Phillips, & Rodriguez, 2000). As children progress through the elementary grades, they also begin to understand that people's actions don't always reflect their thoughts and feelings—for instance, that someone who appears to be happy may actually feel sad (Flavell, Miller, & Miller, 2002; Gnepp, 1989; Selman, 1980).

Early adolescence. Most young adolescents realize that people can have mixed feelings about events and other individuals (Donaldson & Westerman, 1986; Flavell & Miller, 1998; Harter & Whitesell, 1989). And courtesy of their expanding cognitive abilities, memory capacity, and social awareness, young adolescents become capable of recursive thinking (Oppenheimer, 1986; Perner & Wimmer, 1985). That is, they can think about what other people might be thinking about them and eventually can reflect on other people's thoughts about them through multiple iterations (e.g., "You think that I think that you think . . ."). This isn't to say that adolescents (or adults, for that matter) always use this capacity, however. Consistent with our earlier discussion of the *imaginary audience,* focusing primarily about one's *own* perspective is a common phenomenon in the early adolescent years (Tsethlikai & Greenhoot, 2006; Tsethlikai, Guthrie-Fulbright, & Loera, 2007).

Late adolescence. In the high school years, teenagers can draw on a rich body of knowledge derived from numerous social experiences. Consequently, most of them become ever more skillful at drawing inferences about people's psychological characteristics, intentions, and needs (Eisenberg, Carlo, Murphy, & Van Court, 1995; Paget, Kritt, & Bergemann, 1984). In addition, they're more attuned to the complex dynamics that influence behavior—not only thoughts, feelings, and present circumstances but also past experiences (C. A. Flanagan & Tucker, 1999; Selman, 1980). What we see emerging in the high school years, then, are budding psychologists: individuals who can be quite astute in deciphering and explaining the motives and actions of others.

Promoting perspective taking. Virtually any classroom offers many opportunities for perspective taking. One strategy is to talk frequently about people's thoughts, feelings, and motives (Ruffman, Slade, & Crowe, 2002; Wittmer & Honig, 1994; Woolfe, Want, & Siegal, 2002). In the process, we must, of course, use age-appropriate language. With first graders we might use such words as *think, want,* and *sadness.* With fifth graders we might talk about *misunderstanding, frustration,* and *mixed feelings.* Most high school students have the cognitive and social reasoning capabilities to understand fairly abstract and complex psychological terms, such as *being passive-aggressive* and *having an inner moral compass.*

Another important strategy is to take advantage of situations in which people have diverse perspectives and beliefs about a situation. For example, in times of disagreement or conflict, students and teachers alike benefit from putting themselves in the other party's shoes (Adalbjarnardottir & Selman, 1997; Gehlbach, Brinkworth, & Harris, 2012). And when two or more students clash in the classroom or elsewhere on school grounds, an effective approach is *peer mediation,* in which specially trained peers elicit their differing points of view and help them reach an equitable solution (Deutsch, 1993; D. W. Johnson & Johnson, 1996, 2006).

Opportunities for perspective taking also arise in lessons about academic subject matter. For example, in discussions of current events, teachers might have different students—or, using the Internet, same-age classes at different schools—take various countries' perspectives as they explore significant world problems, such as climate change or arms control (Gehlbach et al., 2008).

SOCIAL INFORMATION PROCESSING

Children and adolescents have a lot to think about when they consider what other people are thinking, feeling, and doing. The mental processes involved in understanding and responding to social events are collectively known as social information processing (e.g., Burgess, Wojslawowicz, Rubin, Rose-Krasnor, & Booth-LaForce, 2006; Fontaine, Yang, Dodge, Bates, & Pettit, 2008; E. R. Smith & Semin, 2007). Among other things, social information processing involves paying *attention* to certain behaviors in a social situation and trying to *interpret* and make sense of those behaviors. For example, when students interact with classmates, they might focus on certain remarks, facial expressions, and body language and try to figure out what a classmate really means by, say, a thoughtless comment or sheepish grin. Students also consider one or more *goals* they hope to achieve during an interaction—perhaps preserving a friendship, on the one hand, or teaching

somebody a "lesson," on the other. Then, taking into account both their interpretations and their goals, students draw on their previous knowledge and experiences to identify a number of possible responses and choose what is, in their eyes, a productive course of action. As you'll see in the next section, an understanding of social information processing is especially helpful in explaining why some students are unusually aggressive toward their peers.

AGGRESSION

Aggression is an action intentionally taken to hurt another person either physically or psychologically. The word typically brings to mind some form of **physical aggression** (e.g., hitting, shoving), which can potentially cause bodily injury. But it may instead involve **psychological aggression**—an action intended to cause mental anguish or reduce self-esteem. In some cases, psychological aggression is specifically aimed at undermining friendships and other interpersonal relationships—perhaps by spreading unkind rumors or ostracizing someone from a valued social group—in which case it's also called **relational aggression**. As a general rule, aggression declines over the course of childhood and adolescence, but it increases for a short time after students make the transition from elementary school to middle school or junior high (Bradshaw, Waasdorp, & O'Brennan, 2013; Pellegrini, 2002).

Researchers have identified two distinct groups of aggressive students (Crick & Dodge, 1996; Poulin & Boivin, 1999; Vitaro, Gendreau, Tremblay, & Oligny, 1998). Those who engage in **proactive aggression** deliberately initiate aggressive behaviors as a means of obtaining desired goals. Those who engage in **reactive aggression** act aggressively primarily in response to frustration or provocation. Of the two groups, students who exhibit proactive aggression are more likely to have trouble maintaining productive friendships (Hanish, Kochenderfer-Ladd, Fabes, Martin, & Denning, 2004; Poulin & Boivin, 1999). Those who direct considerable aggression toward particular peers—whether it be physical or psychological aggression—are known as **bullies**. Students who are immature, anxious, and socially isolated are frequent victims of bullies, as are students with nontraditional sexual orientations and students with disabilities (Hamovitch, 2007; J. P. Robinson & Espelage, 2012; M. W. Watson, Andreas, Fischer, & Smith, 2005).

Some children and adolescents are genetically more predisposed to aggression than their peers, and others may exhibit heightened aggression as a result of neurological abnormalities (Brendgen et al., 2008; Raine, 2008; van Goozen, Fairchild, & Harold, 2008). But environmental factors can foster aggressive behavior as well. Many aggressive students live in dysfunctional conditions at home, perhaps including frequent conflicts and displays of anger, harsh punishment or child maltreatment, and a general lack of affection and appropriate social behavior (Christenson, 2004; Maikovich, Jaffee, Odgers, & Gallop, 2008; Pettit, 2004). In addition, regular exposure to violence in the community or through various media (e.g., television, music, video games) seems to increase aggressive behavior in young people (C. A. Anderson et al., 2003; Guerra, Huesmann, & Spindler, 2003; Huesmann, Moise-Titus, Podolski, & Eron, 2003; Prot et al., 2014).

It's important to note here that many children and adolescents who are routinely exposed to violence at home or elsewhere are *not* especially aggressive (Margolin & Gordis, 2004; M. J. Pearce, Jones, Schwab-Stone, & Ruchkin, 2003). Certain cognitive and motivational factors seem to underlie aggressive behavior, including the following:

- *Poor perspective-taking ability.* Students who are highly aggressive tend to have limited ability to look at situations from other people's perspectives or to empathize with their victims (Coie & Dodge, 1998; Damon & Hart, 1988; Marcus, 1980).
- *Misinterpretation of social cues.* Students who are aggressive toward peers tend to interpret others' behaviors as reflecting hostile intentions, especially when those behaviors have ambiguous meanings. This hostile attributional bias is especially prevalent in children who are prone to *reactive* aggression (Bukowski, Brendgen, & Vitaro, 2007; Crick, Grotpeter, & Bigbee, 2002; Dodge et al., 2003).
- *Prevalence of self-serving goals.* For most students, establishing and maintaining interpersonal relationships is a high priority. For aggressive students, however, achieving more self-serving goals—perhaps maintaining an inflated self-image, seeking revenge, or gaining power and dominance—often takes precedence (Baumeister et al., 1996; Cillessen & Rose, 2005; Menon et al., 2007; Pellegrini, Roseth, Van Ryzin, & Solberg, 2011).

- *Ineffective social problem-solving strategies.* Aggressive students often have little knowledge of how to persuade, negotiate, or compromise. Instead, they're apt to resort to hitting, shoving, barging into play activities, and other ineffective strategies (Neel, Jenkins, & Meadows, 1990; D. Schwartz et al., 1998; Troop-Gordon & Asher, 2005).
- *Belief in the appropriateness and effectiveness of aggression.* Many aggressive students believe that violence and other forms of aggression are acceptable ways of resolving conflicts and retaliating against others' misdeeds (Paciello, Fida, Tramontano, Lupinetti, & Caprara, 2008; M. W. Watson et al., 2005; Zelli, Dodge, Lochman, & Laird, 1999). Those who display high rates of *proactive* aggression are also apt to believe that aggressive action will yield positive results—for instance, that it will enhance social status at school or restore "honor" to one's family or social group (R. P. Brown, Osterman, & Barnes, 2009; Mayeux et al., 2011; Pellegrini & Bartini, 2000). Not surprisingly, aggressive children tend to associate with one another, thereby confirming one another's beliefs that aggression is appropriate (Crick, Murray-Close, Marks, & Mohajeri-Nelson, 2009; Espelage & Swearer, 2004).

Both initiators and recipients of aggression often have problems later on. Unless adults actively intervene, many aggressive students (especially those who exhibit proactive aggression) show a continuing pattern of aggression and violence as they grow older, and such a pattern almost guarantees long-term maladjustment and difficulties with peers (Dodge et al., 2003; Ladd & Troop-Gordon, 2003; Swearer et al., 2010). Meanwhile, children who are frequent targets of bullying can become anxious and depressed—sometimes suicidal—and may frequently skip school or even drop out altogether (Cornell, Gregory, Huang, & Fan, 2013; Hoglund, 2007; Ladd et al., 2012). Often the psychological aggression involved in bullying—taunts, name-calling, blatant exclusion from social activities, and the like—causes more long-term harm than any physical aggression that accompanies it (Bradshaw et al., 2013; Doll, Song, & Siemers, 2004; Goodwin, 2006).

Even innocent bystanders tend to suffer from the aggression they witness at school. For example, when they observe one classmate bullying another, their own sense of safety at school diminishes (M. J. Mayer & Furlong, 2010; Rivers, Poteat, Noret, & Ashurst, 2009). Furthermore, if they see bullying and other aggressive behaviors going unpunished, they may come to believe that such actions are perfectly acceptable (E. J. Meyer, 2009; D. T. Miller & Prentice, 1994).

TECHNOLOGY AND PEER RELATIONSHIPS

Thanks to wireless technologies (e.g., cell phones) and the Internet, many students now communicate quite frequently—daily, sometimes almost hourly—with some of their peers (Crosnoe, 2011; Greenhow et al., 2009; Valkenburg & Peter, 2009). For example, email and instant messaging (i.e., "texting") allow quick and easy ways of asking classmates about homework assignments, making plans for weekend social activities, and seeking friends' advice and emotional support. Social networking sites (e.g., Facebook, Instagram) provide means of sharing personal information and potentially finding like-minded age-mates. Internet chat rooms allow group discussions about virtually any topic. Judicious use of such mechanisms can enhance students' self-esteem, connectedness with peers, social problem solving, and general psychological well-being (Ellison, Steinfield, & Lampe, 2007; Greenhow et al., 2009; Gross, Juvonen, & Gable, 2002; Valkenburg & Peter, 2009).

Unfortunately, wireless technologies and the Internet also provide vehicles for cyberbullying—electronically transmitting hostile messages, broadcasting personally embarrassing information, or in other ways causing someone significant psychological distress. For example, a student might upload humiliating video footage on YouTube, post malicious (and possibly false) gossip on Facebook, or set up a website on which classmates can "vote" for their class's "biggest loser" or "easiest slut" (Shariff, 2008; Valkenburg & Peter, 2009; Willard, 2007). Cyberbullying can be more harmful than face-to-face bullying, in part because the perpetrators often remain anonymous (and so can't be confronted) and in part because highly defamatory material can spread like wildfire through a large peer group (Kowalski & Limber, 2007; Rivers, Chesney, & Coyne, 2011). Unfortunately, cyberbullying is one form of aggression that *doesn't* seem to decline over the course of adolescence (Bradshaw et al., 2013).

As teachers, we must join with other faculty members and school administrators to talk with students about wise and socially appropriate uses of modern technology, and we must explain in no uncertain terms that cyberbullying in any form—whether it involves taunts, threats, unkind rumors, or any other material that can cause psychological harm to others—is *totally unacceptable.* And, of course, we must monitor students' in-class use of the Internet.

DIVERSITY IN PEER RELATIONSHIPS AND SOCIAL COGNITION

Some students with disabilities have delays in the development of social cognition and, as a result, often have trouble in interpersonal relationships. For example, students with significant delays in their overall cognitive development (i.e., children with intellectual disabilities) typically have limited understanding of appropriate behaviors in social situations (S. Greenspan & Granfield, 1992; Leffert, Siperstein, & Millikan, 2000). Also, some students with seemingly normal cognitive abilities have specific deficits in social cognition. In a mild form of autism known as *Asperger syndrome,* students may show average or above-average academic achievement but have great difficulty drawing accurate inferences from others' behaviors and body language, apparently as a result of a brain abnormality (G. Dawson & Bernier, 2007; Hobson, 2004; Tager-Flusberg, 2007). In addition, many students with chronic emotional and behavioral disabilities have poor perspective-taking and social problem-solving abilities and thus may have few, if any, friends (Espelage, Mebane, & Adams, 2004; Harter et al., 1998; Webber & Plotts, 2008).

Gender differences. Gender differences have been observed in interpersonal behaviors. Boys tend to hang out in large groups, whereas girls tend to favor smaller, more intimate gatherings with close friends (Maccoby, 2002). Also, girls seem to be more astute at reading other people's body language, and they work harder to maintain group harmony (Benenson et al., 2002; Bosacki, 2000; Rudolph et al., 2005). Furthermore, aggression tends to take different forms in boys (who are prone to physical aggression) and in girls (who are more apt to engage in relational aggression, such as disrupting friendships and tarnishing others' reputations) (Card, Stucky, Sawalani, & Little, 2008; Crick et al., 2002; Pellegrini, 2011; Pellegrini & Archer, 2005).

Cultural and ethnic differences. Interpersonal behaviors vary from culture to culture as well. For instance, some cultural groups (e.g., some groups in northern Canada and in the South Pacific) regularly use seemingly antisocial behaviors—especially teasing and ridicule—to teach children to remain calm and handle criticism (Rogoff, 2003). In contrast, many Native Americans, many people of Hispanic heritage, and certain African American communities place particular emphasis on interpersonal relationships and group harmony, and many Asian groups strongly discourage aggression. Children from these backgrounds may be especially adept at negotiation and peace making (Gardiner & Kosmitzki, 2008; P. Guthrie, 2001; Halgunseth et al., 2006; Leonard & Martin, 2013; Rubin et al., 2010; Witmer, 1996).

Moral and Prosocial Development

In the opening case study Lupita helps a classmate interpret a teacher aide's subtle message and assists two others with their puzzles. Such actions are examples of prosocial behavior, behavior aimed at benefiting others more than oneself. Prosocial behaviors—plus such traits as honesty, fairness, and concern about other people's rights and welfare—fall into the domain of morality. By and large, students who think and behave in moral and prosocial ways gain more support from their teachers and peers and, as a result, achieve greater academic and social success over the long run (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Spinrad & Eisenberg, 2009).

Morality and prosocial behavior are complex entities that appear to involve multiple parts of the brain. Certainly the mirror neurons mentioned earlier are involved, as they partially underlie people's ability to look at situations from someone else's perspective. But ultimately moral and prosocial actions also have components that involve distinctly different brain regions, including (a) *emotions* (e.g., affection and concern for others); (b) *complex reasoning abilities* (e.g., logically determining what actions are morally right and wrong); and (c) *implicit values and beliefs* (e.g., immediately "knowing" that an action is morally wrong but without having a good explanation as to why) (Dinh & Lord, 2013; Gallese et al., 2011; Moll et al., 2007; Young & Saxe, 2009).

DEVELOPMENTAL TRENDS IN MORALITY AND PROSOCIAL BEHAVIOR

Most children behave more morally and prosocially as they grow older. Table 3.2 describes the forms that morality and prosocial behavior are apt to take at various grade levels. Some entries in the table reflect the following developmental trends.

- *Even very young children use internal standards to evaluate behavior.* Well before their first birthday, children show that they value prosocial behavior over antisocial behavior, and by age 3 they have some understanding that behaviors causing physical or psychological harm are inappropriate (Hamlin & Wynn, 2011; Helwig, Zelazo, & Wilson, 2001). By age 4 most children understand that causing harm to another person is wrong regardless of what authority figures might tell them and regardless of what consequences certain behaviors may or may not bring (Laupa & Turiel, 1995; Smetana, 1981; Tisak, 1993).

- *Children's capacity to respond emotionally to others' harm and distress increases over the school years.* Within the first 2 or 3 years of life, two emotions important for moral development emerge (Kochanska, Gross, Lin, & Nichols, 2002; M. Lewis & Sullivan, 2005). First, children occasionally show guilt—a feeling of discomfort when they know they've inflicted damage or caused someone else pain or distress. They also feel shame—a feeling of embarrassment or humiliation when they fail to meet their own or other people's standards for moral behavior. Both guilt and shame, although unpleasant emotions, are good signs that children are developing a sense of right and wrong and will work hard to correct their misdeeds (Eisenberg, 1995; Harter, 1999; Narváez & Rest, 1995).

  Guilt and shame are the result of doing something wrong. In contrast, empathy—experiencing the same feelings as someone in unfortunate circumstances—appears in the absence of wrongdoing. Although the mirror neurons mentioned earlier may to some degree underlie human beings' ability to empathize, this ability continues to develop throughout childhood and adolescence (Eisenberg et al., 1995; Rizzolatti & Sinigaglia, 2008; Spinrad & Eisenberg, 2009). When empathy also evokes sympathy—whereby children not only assume another person's feelings but also have concerns for the individual's well-being—it tends to spur prosocial behavior (Batson, 1991; Eisenberg & Fabes, 1998; Malti, Gummerum, Keller, & Buchman, 2009).
- *Children increasingly distinguish between moral and conventional transgressions.* Virtually every culture discourages some behaviors—moral transgressions—because they cause damage or harm, violate human rights, or run counter to basic principles of equality, freedom, or justice. A cultural group typically also discourages certain other behaviors—conventional transgressions—that, although not unethical, violate widely held understandings about how one

should act (e.g., children shouldn't talk back to adults or burp at meals). Conventional transgressions are usually specific to a particular culture; in contrast, many moral transgressions are universal across cultures (Nucci, 2009; Smetana, 2006; Turiel, 2002).

Children's awareness of social conventions increases throughout the elementary school years (Helwig & Jasiobedzka, 2001; Laupa & Turiel, 1995; Nucci & Nucci, 1982). But especially as children reach adolescence, they don't always agree with adults about which behaviors constitute moral transgressions, which ones fall into the conventional domain, and which ones are simply a matter of personal choice. Hence, many adolescents resist rules they think are infringements on their personal freedoms—for instance, rules about clothing, hair style, and talking in class (Nucci, 2009; Smetana, 2005).

- *With age, reasoning about moral issues becomes increasingly abstract and flexible.* To probe children's thinking about moral issues, researchers sometimes present moral dilemmas, situations in which two or more people's rights or needs may be at odds and for which there are no clear-cut right or wrong responses. The scenario in the following exercise is an example.

DEVELOPMENTAL TRENDS

TABLE 3.2 • Moral Reasoning and Prosocial Behavior at Different Grade Levels

GRADE LEVEL	AGE-TYPICAL CHARACTERISTICS	EXAMPLE	SUGGESTED STRATEGIES
 K–2	• Some awareness that behaviors causing physical or psychological harm are morally wrong • Ability to distinguish between behaviors that violate human rights and dignity versus those that violate social conventions • Guilt and shame about misbehaviors that cause obvious harm or damage • Some empathy for, as well as attempts to comfort, people in distress • Appreciation for the need to be fair; fairness seen as strict equality in how a desired commodity is divided	When Jake pushes Otis off the ladder of a playground slide, several classmates are horrified. One child shouts, "That's wrong!" and three others rush to Otis's side to make sure he's not hurt.	• Make standards for behavior very clear. • When students misbehave, give reasons that such behaviors are unacceptable, focusing on the harm and distress they have caused others (i.e., use *induction*, a strategy described later in the chapter). • Encourage students to comfort others in times of distress. • Model sympathetic responses; explain what you're doing and why you're doing it. • Keep in mind that some selfish behavior is typical for the age-group; when it occurs, encourage perspective taking and prosocial behavior.
 3–5	• Knowledge of social conventions for appropriate behavior • Increasing empathy for unknown individuals who are suffering or needy • Recognition that one should strive to meet others' needs as well as one's own; growing appreciation for cooperation and compromise • Growing realization that fairness doesn't necessarily mean equality—that some people (e.g., peers with disabilities) may need more of a desired commodity than others • Increased desire to help others as an objective in and of itself	At the suggestion of his third-grade teacher, 8-year-old Jeff acts as a "special friend" to Evan, a boy with severe physical and cognitive disabilities who joins the class for 2 or 3 days a week. Evan can't speak, but Jeff gives him things to feel and manipulate and talks to him whenever class activities allow conversation. And the two boys regularly sit together at lunch. Jeff comments, "Doing things that make Evan happy makes me happy, too."	• Make prosocial behaviors (e.g., sharing, helping others) a high priority in the classroom. • Explain how students can often meet their own needs while helping others (e.g., when asking students to be "reading buddies" for younger children, explain that doing so will help them become better readers themselves). • Use prosocial adjectives (e.g., *kind*, *helpful*) when praising altruistic behaviors.

 6–8	• Growing awareness that some rules and conventions are arbitrary; in some cases accompanied by resistance to these rules and conventions • Interest in pleasing and helping others, but with a tendency to oversimplify what "helping" requires • Tendency to believe that people in dire circumstances (e.g., homeless people) are entirely responsible for their own fate	After the midwinter break, 13-year-old Brooke returns to school with several large nose rings and her hair styled into long, vertical spikes above her head. The school principal tells her that her appearance is inappropriate and insists that she go home to make herself more presentable. Brooke resists, claiming, "I have a right to express myself however I want!"	Talk about how rules enable classrooms and other groups to run more smoothly. Involve students in group projects that will benefit their school or community. When imposing discipline for moral transgressions, accompany it with explanations about the harm that has been caused (i.e., use *induction*), especially when working with students who appear to have deficits in empathy and moral reasoning.
 9–12	• Increasing concern about doing one's duty and abiding by the rules of society as a whole, rather than simply pleasing certain authority figures • Realization that most rules and conventions serve useful purposes • Genuine empathy for people in distress • Belief that society has an obligation to help people in need	Several high school students propose and establish a school chapter of Amnesty International, an organization dedicated to the preservation of human rights around the world. The group invites knowledgeable guest speakers from various countries and conducts several fundraisers to help combat abusive practices against women.	Explore moral issues in social studies, science, and literature. Encourage community service as a way of engendering a sense of commitment to helping others. Ask students to reflect on their experiences through group discussions or written essays. Have students read autobiographies and other forms of literature that depict heroic figures who have actively worked to help people in need.

Sources: Eisenberg, 1982; Eisenberg & Fabes, 1998; Farver & Branstetter, 1994; C. A. Flanagan & Faison, 2001; Gibbs, 1995; Gummerum, Keller, Takezawa, & Mata, 2008; D. Hart & Fegley, 1995; Hastings et al., 2007; Helwig & Jasiobedzka, 2001; Helwig et al., 2001; Hoffman, 2000; Kohlberg, 1984; Krebs & Van Hesteren, 1994; Kurtines, Berman, Ittel, & Williamson, 1995; Laupa & Turiel, 1995; M. Lewis & Sullivan, 2005; Nucci, 2009; Nucci & Weber, 1995; Rothbart, 2011; Rushton, 1980; Smetana & Braeges, 1990; Spinrad & Eisenberg, 2009; Turiel, 1983, 1998; Wainryb, Brehl, & Matwin, 2005; Yates & Youniss, 1996; Yau & Smetana, 2003; Youniss & Yates, 1999; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992.

Looking for the moral high ground in this situation, you might very well have chosen Alternative *c*. But if you were a ninth grader—someone who might still be working hard to fit in with your peer group—is that *really* what you would do?

In his groundbreaking early research on moral development, Lawrence Kohlberg gave children and adults a variety of moral dilemmas and asked them both what they would do and why they would do it. Based on the hundreds of responses he obtained, Kohlberg proposed that as children grow older, they construct increasingly complex views of morality. In Kohlberg's view, development of moral reasoning is characterized by a sequence of six stages grouped into three general *levels* of morality: preconventional, conventional, and postconventional (see Table 3.3). Children with **preconventional morality** haven't yet adopted or internalized society's conventions regarding what things are right and wrong but instead focus largely on external consequences that certain actions might bring to themselves, as illustrated in Alternative *a* in the exercise. Kohlberg's second level, **conventional morality**, is characterized by general, often unquestioning obedience either to an authority figure's dictates or to established rules and norms, even when there are no consequences for disobedience. Alternative *b* in the exercise is an example: You report a violation of school rules to school authorities, but you don't want to be late to class—that would violate another school rule—and through your actions you don't jeopardize any good relationships you might have with the supposedly "popular" boys.

In contrast to the somewhat rigid nature of conventional morality, people at Kohlberg's third level, **postconventional morality**, view rules as useful but changeable mechanisms that ideally can maintain the general social order and protect human rights and safety; rules aren't absolute dictates that must be obeyed without question. These people live by their own abstract principles about right and wrong and may disobey rules inconsistent with these principles. Alternative *c* has an element of postconventional reasoning: You're more concerned about protecting Martin's physical and psychological safety than you are about getting to class on time.

Considerable research on moral development has followed on the heels of Kohlberg's work. Some of it supports Kohlberg's proposed sequence: Generally speaking, people seem to make advancements in the order Kohlberg proposed (Boom, Brugman, & van der Heijden, 2001; Colby & Kohlberg, 1984; Snarey, 1995; Stewart & Pascual-Leone, 1992). And as Kohlberg suggested, moral development emerges out of children's own, self-constructed beliefs—beliefs they often revisit and revise over time. Nevertheless, his theory has several weaknesses. For one thing, Kohlberg underestimated young children, who, as you discovered earlier, acquire some internal standards of right and wrong long before they reach school age. Also, Kohlberg's stages encompassed a mixture of moral issues (e.g., causing harm) and social conventions (e.g., having rules to help society run smoothly), but as we've seen, children distinguish between these two domains, and their views about each domain may change at different times and in different ways (Nucci, 2001, 2009). Furthermore, Kohlberg's theory pays little attention to a second important aspect of morality—*showing compassion for and helping* other people—and its focus is largely on *reasoning*, with little consideration of people's moral *behaviors* (Gilligan, 1982, 1987; P. L. Hill & Roberts, 2010; J. G. Miller, 2007). Finally, Kohlberg largely overlooked situational factors that young people take into account when deciding what's morally right and wrong in specific contexts (more about these factors in a moment).

COMPARE/CONTRAST

TABLE 3.3 • The Three Levels and Six Stages of Moral Reasoning in Kohlberg's Theory of Moral Development

LEVEL	AGE RANGE	STAGE	NATURE OF MORAL REASONING
Level I: Preconventional morality	Seen in preschool children, most elementary school students, some junior high school students, and a few high school students	Stage 1: Punishment-avoidance and obedience	People make decisions based on what is best for themselves, without regard for others' needs or feelings. They obey rules only if established by more powerful individuals; they may disobey if they aren't likely to get caught. "Wrong" behaviors are those that will be punished.
		Stage 2: Exchange of favors	People recognize that others also have needs. They may try to satisfy others' needs if they can satisfy their own needs at the same time (e.g., "You scratch my back; I'll scratch yours"). They continue to define right and wrong primarily in terms of consequences to themselves.
Level II: Conventional morality	Seen in a few older elementary school students, some junior high school students, and many high school students (Stage 4 typically does not appear before high school)	Stage 3: Good boy/good girl	People make decisions based on what actions will please others, especially authority figures (e.g., teachers, popular peers). They are concerned about maintaining relationships through sharing, trust, and loyalty, and they consider other people's perspectives and intentions when making decisions.
		Stage 4: Law and order	People look to society as a whole for guidelines about right and wrong. They know that rules are necessary for keeping society running smoothly and believe that it's their duty to obey the rules. However, they perceive rules to be inflexible; they don't necessarily recognize that as society's needs change, rules should change as well.
Level III: Postconventional morality	Rarely seen before college (Stage 6 is extremely rare even in adulthood)	Stage 5: Social contract	People recognize that rules represent agreements among many individuals about appropriate behavior. Rules are seen as useful mechanisms that maintain the general social order and protect individual rights, rather than as absolute dictates that must be obeyed simply because they are the law. People also recognize the flexibility of rules; rules that no longer serve society's best interests can and should be changed.
		Stage 6: Universal ethical principles	Stage 6 is a hypothetical, ideal stage that few people ever reach. People in this stage adhere to a few abstract, universal principles (e.g., equality of all people, respect for human dignity, commitment to justice) that transcend specific norms and rules. They answer to a strong inner conscience and willingly disobey laws that violate their own ethical principles.

Sources: Colby & Kohlberg, 1984; Colby, Kohlberg, Gibbs, & Lieberman, 1983; Kohlberg, 1976, 1984, 1986; Reimer, Paolitto, & Hersh, 1983; Snarey, 1995.

Many contemporary developmental psychologists believe that moral reasoning involves general *trends* rather than distinct stages. It appears that children and adolescents gradually construct several different standards that guide their moral reasoning and decision making in various situations. Such standards include the need to address one's own personal interests, consideration of other people's needs and motives, a desire to abide by society's rules and conventions, and, perhaps eventually, an appreciation for abstract ideals regarding human rights and society's overall needs (Killen & Smetana, 2008; Krebs, 2008; Rest, Narvaez, Bebeau, & Thoma, 1999). With age, youngsters increasingly apply more advanced standards, but even a fairly primitive one—satisfying one's own needs without regard for others—may occasionally take priority (Rest et al., 1999; Turiel, 1998).

- *As children get older, they increasingly behave in accordance with their self-constructed moral standards, but other factors come into play as well.* On average, children and adolescents with more advanced moral reasoning behave in more moral and prosocial ways (e.g., Blasi, 1980; P. A. Miller, Eisenberg, Fabes, & Shell, 1996; Paciello et al., 2008). However, the correlation between moral reasoning and moral behavior isn't an especially strong one. Youngsters' perspective-taking ability and emotions (shame, guilt, empathy, sympathy) also influence their decisions to behave morally or otherwise (Batson, 1991; Damon, 1988; Eisenberg, Zhou, & Koller, 2001). And although young people may truly want to do the right thing, they may also be concerned about the consequences for themselves in specific situations—for instance, how much personal sacrifice will be involved and how much various actions will gain other people's approval or respect (Batson & Thompson, 2001; Cillessen et al., 2011; Hawley, 2014; Narváez & Rest, 1995; Wentzel, Filisetti, & Looney, 2007).

  Finally, sense of self seems to be an important factor affecting one's inclinations to act morally and prosocially. Young people must believe they're actually capable of helping other people—in other words, they must have high self-efficacy about their ability to "make a difference" (Narváez & Rest, 1995). Furthermore, in adolescence, some of them begin to integrate a commitment to moral values into their overall sense of identity: They think of themselves as moral, caring individuals who make other people's rights and well-being a high priority (Blasi, 1995; Hastings, Utendale, & Sullivan, 2007; Thorkildsen et al., 2008).

FACTORS INFLUENCING MORAL AND PROSOCIAL DEVELOPMENT

To some degree, advanced moral reasoning depends on *cognitive development.* In particular, it depends on the ability to think simultaneously about multiple issues (e.g., about various people's motives and intentions in a situation) and also on the ability to comprehend such abstract ideals as justice and basic human rights. However, cognitive development doesn't *guarantee* moral development. It's quite possible to think abstractly about academic subject matter and yet reason in a self-centered, preconventional manner (Kohlberg, 1976; Nucci, 2006, 2009; Turiel, 2002).

Children's social and cultural environments have a significant influence on their moral and prosocial development. For example, when children see adults or peers being generous and showing concern for others, they tend to do likewise (Hoffman, 2000; Rushton, 1980; Spinrad & Eisenberg, 2009). And when they watch television shows that emphasize perspective taking and prosocial actions, they're more inclined to exhibit such behaviors themselves (Dubow, Huesmann, & Greenwood, 2007; Hearold, 1986; Rushton, 1980; Singer & Singer, 1994). Prosocial video games, too, seem to have a positive impact (Greitemeyer, 2011; Prot et al., 2014). Ideally, society's prosocial messages must be consistently conveyed through other people's behaviors. Children do *not* make advancements in moral reasoning and behavior simply by hearing adults advocate certain moral values—say, through a short "character education" program (Higgins, 1995; N. Park & Peterson, 2009; Turiel, 1998).

Children also tend to make gains in moral and prosocial development when adults consistently use induction, asking children to think about the harm and distress that some of their behaviors have caused others (Hoffman, 2000; Rothbart, 2011). Induction is victim-centered: It helps youngsters focus on others' distress and recognize that they themselves have been the cause. Consistent use of induction in disciplining children, especially when accompanied by *mild* punishment for misbehavior—for instance, insisting that children make amends for their

wrongdoings—appears to promote compliance with rules and foster the development of empathy, compassion, and altruism (G. H. Brody & Shaffer, 1982; Hoffman, 1975; Nucci, 2001; Rushton, 1980).

Yet another factor that appears to promote moral and prosocial advancements is *disequilibrium*—in particular, encountering moral dilemmas and arguments that children can't adequately address with their current moral standards and viewpoints. For instance, classroom discussions of controversial topics and moral issues can promote increased perspective taking and a gradual transition to more advanced reasoning (DeVries & Zan, 1996; Power, Higgins, & Kohlberg, 1989; Schlaefli, Rest, & Thoma, 1985). As Kohlberg suggested, children *construct* (rather than absorb) their moral beliefs; disequilibrium can spur them to revise their beliefs in ways that allow them to consider increasingly complex moral issues.

DIVERSITY IN MORAL AND PROSOCIAL DEVELOPMENT

Some diversity in moral and prosocial development is, of course the result of differences in children's environments. But biology seems to be involved as well. For example, other things being equal, children who have a somewhat fearful, anxious temperament in infancy tend to show more guilt and empathy in the early elementary grades than their less anxious classmates. And as children grow older, the degree to which they show effortful control—an ability to inhibit selfish and other unproductive impulses—appears to be a factor in their acquisition of a moral conscience (Eisenberg, Spinrad, & Sadovsky, 2006; Kochanska, Tjebkes, & Forman, 1998; Rothbart, 2011).

Genetically based disabilities, too, come into the picture. For example, certain human genes seem to give rise to the development of brain abnormalities that, in turn, predispose their owners to antisocial behavior (Raine, 2008; Viding & McCrory, 2012).

Gender differences. Researchers have observed minor gender differences in moral and prosocial development. For instance, on average, girls are more likely than boys to feel guilt and shame—in part because they're more willing to take personal responsibility for their misdeeds. Girls are also more likely to feel empathy for people in distress (Alessandri & Lewis, 1993; Lippa, 2002; A. J. Rose, 2002; Zahn-Waxler & Robinson, 1995).

Historically, researchers have disagreed about the extent to which girls and boys *reason* differently about situations involving moral issues. In his work with college students, Kohlberg found that males reasoned at a slightly more advanced level than females (Kohlberg & Kramer, 1969). In response, psychologist Carol Gilligan argued that Kohlberg's stages don't adequately describe female moral development (Gilligan, 1982, 1987; Gilligan & Attanucci, 1988). She suggested that Kohlberg's stages reflect a *justice orientation*—an emphasis on fairness and equal rights—that characterizes males' moral reasoning. In contrast, females are socialized to take a *care orientation* toward moral issues—that is, to focus on interpersonal relationships and take responsibility for others' well-being. To see how these two orientations might play out differently, try the following exercise.

EXPERIENCING FIRSTHAND
THE PORCUPINE DILEMMA

Consider the following scenario:

> A group of industrious, prudent moles have spent the summer digging a burrow where they will spend the winter. A lazy, improvident porcupine who has not prepared a winter shelter approaches the moles and pleads to share their burrow. The moles take pity on the porcupine and agree to let him in. Unfortunately, the moles did not anticipate the problem the porcupine's sharp quills would pose in close quarters. Once the porcupine has moved in, the moles are constantly being stabbed. (Meyers, 1987, p. 141, adapted from Gilligan, 1985)

What do you think the moles should do? Why?

According to Gilligan, males are apt to view the problem as involving a violation of someone's rights: The moles own the burrow and so can legitimately evict the porcupine. In contrast, females are more likely to show compassion, perhaps suggesting that the moles cover the porcupine with a blanket so that his quills won't annoy anyone (Meyers, 1987).

Gilligan raised a good point: Males and females are often socialized quite differently. Furthermore, by including compassion for other human beings as well as consideration for their rights, Gilligan broadened our conception of what morality *is* (L. J. Walker, 1995). But in fact, most research studies *don't* find major gender differences in moral reasoning (Eisenberg, Martin, & Fabes, 1996; Nunner-Winkler, 1984; L. J. Walker, 1991). And as Gilligan herself has acknowledged, males and females alike typically reveal concern for both justice and compassion in their reasoning (L. M. Brown, Tappan, & Gilligan, 1995; Gilligan & Attanucci, 1988; Turiel, 1998).

Cultural and ethnic differences. Virtually all cultures worldwide acknowledge the importance of individual rights and fairness (reflecting a *justice* orientation) and of compassion for others (reflecting a *care* orientation). Yet until recently researchers have largely overlooked certain other values that may be key components of morality in certain cultures:

- *Loyalty to one's own group,* with a sense of "all for one, and one for all," possibly accompanied by feelings of animosity toward other groups
- *Respect for and obedience to authority figures,* with willing acceptance of a subordinate position in a social decision-making hierarchy
- *Sacredness of certain beings, objects, or life in general,* with unswerving reverence and devotion to these things
- *Liberty,* with preservation of everyone's individual choices and decision making taking precedence over any needs of the larger group (Haidt, 2012)

People can't simultaneously be "moral" in all six ways; for instance, obedience to authority figures conflicts with personal liberties, and loyalty to one's own group can sometimes diminish one's respect for the rights of *other* groups. Accordingly, different cultural groups prioritize these various elements somewhat differently (Haidt, 2012; J. G. Miller, 2007). For example, in much of North America, helping others (or not) is considered to be a voluntary choice—reflecting respect for individual liberties—but in some societies (e.g., in many Asian and Arab countries) it is one's moral *duty* to help people in need. Such a sense of duty, which is often coupled with a strong sense of loyalty to family and the community, can lead to considerable prosocial behavior (X. Chen et al., 2009; Markus & Kitayama, 1991; Rubin et al., 2010).

Some diversity is also seen in the behaviors that cultural groups view as moral transgressions versus those they see as conventional transgressions (Haidt, 2012; Nucci, 2001, 2009). For example, in mainstream Western culture, how one dresses is largely a matter of convention and personal choice. In some deeply religious groups, however, certain forms of dress (e.g., head coverings) are seen as moral imperatives. As another example, in mainstream Western culture, telling lies to avoid punishment for inappropriate behavior is considered morally wrong, but it's a legitimate way of saving face in certain other cultures (Triandis, 1995). As teachers, then, we must remember that our students' notions of morally appropriate and inappropriate behaviors may sometimes be quite different from our own. At the same time, we must *never* accept behaviors that violate such basic principles as equality and respect for other people's rights and well-being.

Islamic Online University
Lecture Notes for Modules 7 & 8

TEXTBOOK CHAPTER 4: GROUP DIFFERENCES

LEARNING OUTCOMES

1 Describe frequently observed between-group differences and within-group variability for various cultural and ethnic groups; also describe the teacher attitudes and strategies that underlie culturally responsive teaching.
2 Describe the nature and origins of typical gender differences in school-age children adolescents, and explain how you might best accommodate such differences in your classroom.
3 Identify challenges that students from low-income families often face; also identify several strategies through which you can foster their resilience and help them be successful at school.
4 Explain how you might recognize students who are at risk for academic failure and dropping out of school, and identify strategies for helping these students stay in school and get on the path on academic and social success.

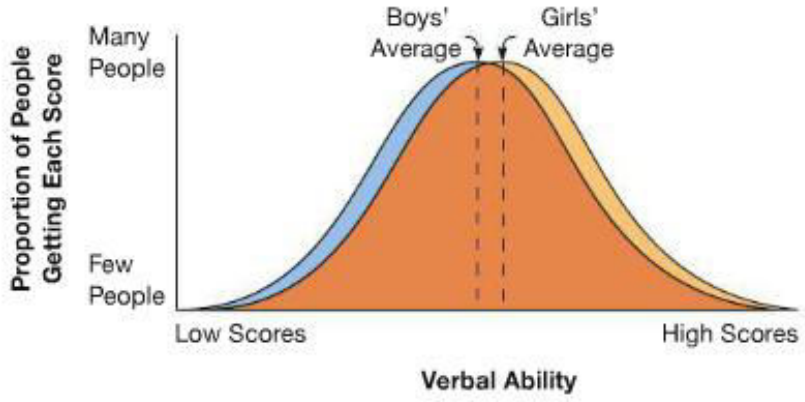
well) (Gallimet, Jones, & Dahl, 2011).

In this chapter we'll look in depth at group differences—differences we're apt to see *on average* among students of diverse cultural and ethnic groups, different genders, and different socioeconomic backgrounds. As we do so, we must keep in mind three very important points. First, *a great deal of individual variability exists within any group.* We'll be examining research regarding how students of different groups behave *on average,* even though many students within each group are not at all like those averages. Second, *a great deal of overlap typically exists between two groups.* Consider gender differences in verbal ability as an example. Many research studies have found girls to have slightly higher verbal ability than boys (Halpern & LaMay, 2000). The difference is often statistically significant—that is, it probably wasn't a one-time-in-a-hundred fluke that happened simply by chance. Yet the average difference between girls and boys in overall verbal ability is quite small, with a great deal of overlap between the sexes. Figure 4.1 shows the typical overlap between girls and boys on general measures of verbal ability. Notice that some boys (those whose scores fall in the rightmost part of their curve) have higher verbal ability than most of their female peers despite the average advantage for girls.

We also need to be aware that group differences shouldn't always be taken at face value. Some of the differences often reported by the media actually are somewhat more complex when examined more critically. For example, let's consider the achievement gap between Hispanic and European American students in the United States. Whereas European American students, overall, tend to achieve at higher levels in both math and reading than do Hispanic students, there actually is much variation in the achievement gap across U.S. states. For example, achievement gaps are lower than the national average in some states (e.g., Florida, Georgia, and Kentucky), and larger than the national average gap in other states (e.g., California, Connecticut, and Rhode Island) (Hemphill, Vanneman, & Rhaman, 2011).

Keep in mind that there are many forms of diversity, not just the ones covered in this chapter. Throughout our careers, we will will encounter many types of diversity in our classrooms. We need to be aware of these possibilities, and use the presence of uniquely diverse students as an opportunity for learning, respect, and appreciation of diversity for all students. Examples could include students whose parents are of the same gender, students who have been adopted either domestically or internationally, students who are HIV or hepatitis positive, or students who have a particularly unique cultural background (e.g., a student who has recently moved here from Iceland).

FIGURE 4.1 Typical "difference" between boys and girls on tests of verbal ability.

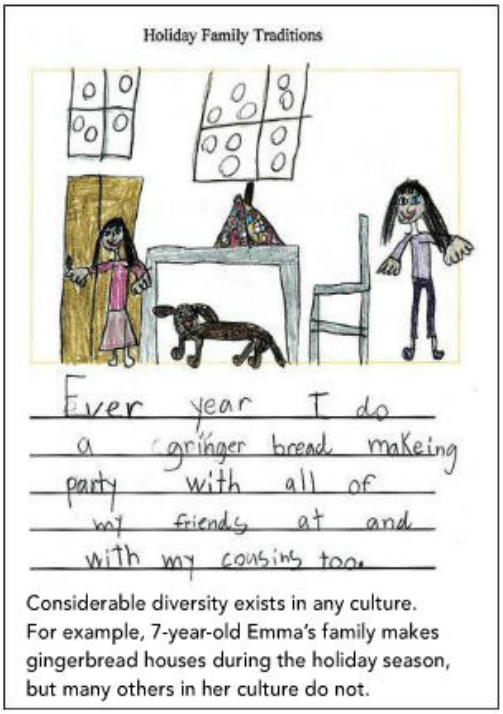


Cultural and Ethnic Differences

The concept of culture encompasses the behaviors and belief systems that characterize a long-standing social group. Our cultures affect virtually every aspect of our lives. The culture in which we live influences the perspectives and values we acquire, the skills we find important and master, and the adult roles to which we aspire. It also guides the development of our language and communication skills, our expression and regulation of emotions, and our formation of a sense of self. Sometimes we use the word *culture* to refer to behaviors and beliefs that are widely shared over a large geographic area. For example, *mainstream Western culture* encompasses behaviors, beliefs, and values shared by many people in North America and western Europe. Members of this culture generally value self-reliance, academic achievement, democratic decision making, and respect for other individuals' rights and possessions, among other things. However, any single country in North America or western Europe—in fact, almost every country on the planet—encompasses considerable cultural diversity within its borders. Some of this within-country diversity is the result of growing up in particular geographic regions, religious groups, or socioeconomic circumstances (A. B. Cohen, 2009; Payne, 2005; Rasmussen & Lavish, 2014).

In addition, most countries include citizens from a variety of ethnic groups. In general, an ethnic group is a group of individuals with a common culture and the following characteristics:

- Its roots either precede the creation of or are external to the country in which it resides. It may be comprised of people of the same race, national origin, or religious background.
- Its members share a sense of interdependence—a sense that their lives are intertwined. (NCSS Task Force on Ethnic Studies Curriculum Guidelines, 1992)



Considerable diversity exists in any culture. For example, 7-year-old Emma's family makes gingerbread houses during the holiday season, but many others in her culture do not.

Ethnic groups are often confused with racial groups. Definitions and conceptualizations of race vary greatly (Spencer et al., 2012), and, as teachers, we need to be aware that many students and parents will have diverse attitudes toward race. Racial groups generally are based on physical differences between groups of people; those physical differences are usually genetic in origin. Thus a student might belong to the Caucasian racial group, but the student may also belong to several ethnic groups (e.g., the student might identify as being Catholic and Italian).

Cultures aren't static entities. Instead, they continue to change over time as people incorporate new ideas, innovations, and ways of thinking, and as they interact with other cultures (Kitayama, Duffy, & Uchida, 2007; O. Lee, 1999; Rogoff, 2003). Furthermore, there's considerable variation in attitudes and behaviors within a particular culture; individual members may adopt some cultural values and practices but reject others (Goodnow, 2010; Markus & Hamedani, 2007). For example, you might encounter a student who comes from a culture that prohibits eating certain foods and does not afford equal rights to males and females. You may notice, however, that your student accepts cultural norms for diet but also rejects the notion of gender inequality.

When people come into contact with a culture very different from their own (e.g., through immigration to a new country), many of them—especially children—gradually undergo acculturation, adopting some of the new culture's values and customs. Some acculturation is critical for success in the new cultural environment, but *rapid* acculturation can be detrimental to children's

social and emotional well-being. In most instances, children's own cultural groups give them a support network and stable set of values that enable them to do well in school and maintain their self-esteem in the face of discrimination and other challenges (Deyhle, 2008; Matute-Bianchi, 2008; Sam & Berry, 2010).

In general, we can get the best sense of students' cultural backgrounds and ethnic-group memberships by learning the extent to which they have participated and continue to participate in various cultural and ethnic-group activities (Gutiérrez & Rogoff, 2003). For example, some Mexican American students live in small, close-knit communities where Spanish is spoken and traditional Mexican practices and beliefs permeate everyday life, but others live in more culturally heterogeneous communities in which Mexican traditions may be cast aside to make time for mainstream American activities. And in some instances students may participate actively in two or more cultures, perhaps because they have emigrated from one country to another or perhaps because their parents come from distinctly different ethnic or racial backgrounds (Herman, 2004; A. M. Lopez, 2003; Mohan, 2009). In general, *membership in a particular cultural or ethnic group is a more-or-less phenomenon rather than an either-or situation.* In this age of increasing cross-cultural interaction, many students cannot easily be pigeonholed.

NAVIGATING DIFFERENT CULTURES AT HOME AND AT SCHOOL

When they first begin school, many children experience some *culture shock*—confusion about the behaviors expected of them in this new setting. Culture shock is more intense for some students than for others. Most schools in North America and western Europe embrace the norms and values of mainstream Western culture, and so students with this cultural background often adjust quickly to classroom practices. In contrast, students who come from cultural groups with radically different norms and values may experience a cultural mismatch between home and school. In particular, they may find school an unsettling place in which they don't know what to expect from others or what behaviors other people expect of *them.* Significant differences between home and school cultures can interfere with students' adjustment to the school setting and ultimately with their academic achievement as well (Phelan, Yu, & Davidson, 1994; Turner, 2015; Tyler et al., 2008; Ward, Bochner, & Furnham, 2001).

As students gain experience with the culture of their school, they become increasingly aware of their teachers' and peers' expectations for behavior and ways of thinking, and many eventually become adept at switching their cultural vantage point as they move from home to school and back again (Y. Hong, Morris, Chiu, & Benet-Martínez, 2000; LaFromboise, Coleman, & Gerton, 1993; Matute-Bianchi, 2008). One Mexican American student's recollection provides an example:

> At home with my parents and grandparents the only acceptable language was Spanish; actually that's all they really understood. Everything was really Mexican, but at the same time they wanted me to speak good English. . . . But at school, I felt really different because everyone was American, including me. Then I would go home in the afternoon and be Mexican again. (Padilla, 1994, p. 30)

Not all students make an easy adjustment, however. Some students actively resist adapting to the school culture, perhaps because they view it as conflicting with their own cultural background and identity (Cross, Strauss, & Fhagen-Smith, 1999; Gay, 2010; Irving & Hudley, 2008; Phelan et al., 1994). Still others try desperately to fit in at school yet find the inconsistencies between home and school difficult to resolve, as illustrated by this report from a teacher whose students included immigrant Muslim children from Pakistan and Afghanistan:

> During the days of preparation for Ramadan Feast, the children fasted with the adults. . . . They had breakfast [before dawn] and then went back to sleep until it was time to get themselves ready for school. In school they refrained from food or drink—even a drop of water—until sunset. By noon, especially on warm days, they were a bit listless. . . . They spoke about their obligation to pray five times daily. In their writing they expressed the conflict within:
>
> > *I always think about my country. I think about going there one day, seeing it and practicing my religion with no problems. . . . Before sunrise, I can pray with my family. But at school we can't say to my teacher, "Please, teacher, I need to pray."* (Igoa, 1995, p. 135)

As teachers, we must learn as much as we can about the ways in which students from various cultural and ethnic groups are apt to be different from one another and from ourselves. Equipped with such knowledge, we can make reasonable accommodations to help students from all backgrounds adjust to and thrive in our classrooms.

EXAMPLES OF CULTURAL AND ETHNIC DIVERSITY

Tremendous cultural variation exists within African American, Hispanic, Asian American, Native American, European American, and numerous other groups. Thus, we must be careful not to form stereotypes about *any* group. At the same time, knowledge of frequently observed cultural differences, such as those described in the following sections, can sometimes help us better understand why students behave as they do.

LANGUAGE AND DIALECT

One obvious cultural difference is language. Although most students speak English at school, our students may experience different language environments outside of school. In the United States, 21.8% of children between the ages of 5 through 14 speak a language other than English at home (U.S. Census Bureau, 2013). There can also be much variation within individual students' homes regarding how much English or another language is used (Branum-Martin, Mehta, Carlson, Francis, & Goldenberg, 2014). Whereas the entire family may speak another language almost all of the time in some homes, in other homes, one parent may speak English much of the time. But even if children speak English at home, they may use a form of English different from the Standard English typically used at school. More specifically, they may speak in a different dialect, a form of a particular language that includes some unique pronunciations, idioms, and grammatical structures. Dialects tend to be associated either with particular geographical regions or with particular ethnic and cultural groups.

Perhaps the most widely studied ethnic dialect is African American English (you may also see the terms *Black English Vernacular* and *Ebonics*). This dialect—which is illustrated in the earlier "Argument" exercise and is actually a group of dialects that vary somewhat from place to place

—is characterized by certain ways of speaking that are distinctly different from those of Standard English (e.g., "He got ten dollar," "Momma she mad," "He be talkin' ") (Hulit & Howard, 2006, p. 346; Owens, 1995, p. A-8). At one time, many researchers believed that an African American dialect represented a less complex form of speech than Standard English and thus urged educators to teach students to speak "properly" as quickly as possible. But most researchers now realize that African American dialects are, in fact, very complex languages with predictable sentence structures and that these dialects promote communication and sophisticated thinking processes as readily as Standard English (Alim & Baugh, 2007; Fairchild & Edwards-Evans, 1990; Hulit & Howard, 2006; Spears, 2007).

Many children and adolescents view their native dialect as an integral part of their ethnic identity. Furthermore, when a particular dialect is the language preferred by local community members, it's often the means through which people can most effectively connect with one another in face-to-face interactions and text messaging (Godley & Escher, 2011; Ogbu, 2003; D. Paris & Kirkland, 2011).

Nevertheless, lack of proficiency in Standard English can impede children's reading and writing development, and in later years, their use of a distinct regional or cultural dialect may lead other people to underestimate or discredit their abilities. For such reasons, many experts recommend that all students in English-speaking countries develop proficiency in Standard English. Ultimately, children and adolescents function most effectively when they can use both their local dialect and Standard English in appropriate settings. For example, although we may wish to encourage Standard English in most written work or in formal oral presentations, we might find other dialects quite appropriate in creative writing or informal classroom discussions (Adger et al., 2007; DeBose, 2007; Ogbu, 1999, 2003; Smitherman, 1994). In general, being aware of and accommodating students' cultural differences in language use can enhance our ability to educate students from diverse linguistic backgrounds (Bailey, Osipova, & Reynolds-Kelly, 2015).

TALKATIVENESS AND VERBAL ASSERTIVENESS

Relatively speaking, mainstream Western culture is a chatty one. People often say things to one another even when they have little to communicate, making small talk a way of maintaining interpersonal relationships (Gay, 2010; Trawick-Smith, 2003). In some African American communities as well, people talk a lot, often with a great deal of energy and enthusiasm (Gay, 2006; Tyler et al., 2008). In certain other cultures, however, silence is golden (Norenzayan, Choi, & Peng, 2007; Trawick-Smith, 2003). For example, many people from Southeast Asian countries believe that effective learning is best accomplished through attentive listening rather than through speaking (J. Li, 2005; J. Li & Fischer, 2004; Volet, 1999).

Some talkative cultures are also assertive ones, in that people readily voice their opinions, perhaps interrupting those who are speaking; for example, this is the case for many African Americans, European Americans, and Hawaiians. People from quieter cultures, such as many Asian Americans, tend to be more subtle and tentative in expressing their opinions—for instance, they might begin a sentence by saying "I'm not sure, but perhaps . . . "—and they aren't as likely to reveal their emotions during conversations (Gay, 2010; Morelli & Rothbaum, 2007; Tyler et al., 2008; Ward et al., 2001).

In addition, different cultural and ethnic groups have diverse views about how assertive children should be with adults. In mainstream Western culture a common expectation is that children will speak up whenever they have comments or questions. Yet in many parts of the world, children are expected to learn primarily by close, quiet observation of adults, rather than by asking questions or otherwise interrupting what adults are doing (Correa-Chávez, Rogoff, & Mejía Arauz, 2005; Gutiérrez & Rogoff, 2003; Kağitçibaşi, 2007). And in some cultures—for instance, in many Mexican American and Southeast Asian communities and in some African American communities—children learn very early that they should engage in conversation with adults only when their participation has been directly solicited (Delgado-Gaitan, 1994; C. A. Grant & Gomez, 2001; Ochs, 1982).

As teachers, we need to be sensitive to such differences in talkativeness, particularly when students have recently arrived from another country. A student who has recently moved from a culture where children and adolescents are socialized to be quiet in classrooms may find the linguistic environments in Western classrooms disruptive and disrespectful. Parents of such students

VIEWS ABOUT TEASING

Although people in some cultures think of teasing as mean spirited, it's a common form of social interaction in certain other cultures. For example, in the earlier "Argument" exercise, two African American boys engaged in playful one-upmanship, flinging increasingly outlandish insults at each other. And in the opening case study, Jack's mother teased him by suggesting that "Now maybe school will look easy!" When taken in the right spirit, teasing serves a variety of functions for particular cultural groups—perhaps providing a source of amusement and an outlet for verbal creativity, exerting gentle pressure to engage in more productive behavior, or helping children learn how to take criticism in stride (Adger et al., 2007; P. M. Cole, Tamang, & Shrestha, 2006; Rogoff, 2003). As teachers, we need to pay particular attention to instances when students from different cultural backgrounds tease one another. Whereas it may be acceptable for students from within a specific cultural group to tease each other, boundaries may be crossed when students from outside of that cultural group engage in the teasing.

COOPERATION VERSUS COMPETITION

In a traditional Western classroom, students are rewarded when, as individuals, they achieve at high levels. In some cases—for example, when teachers grade on a curve or post "best" papers on a bulletin board—students must actually compete with one another in order to be successful.

Yet in some cultures—including many Native American, Mexican American, African, Southeast Asian, and Pacific Island communities—*group* achievement is valued over individual success. Students from these cultures are often more accustomed to working cooperatively and for the benefit of the community, rather than for themselves, and value humility about their personal accomplishments (X. Chen, Chung, & Hsiao, 2009; Lomawaima, 1995; Mejía-Arauz, Rogoff, Dexter, & Najafi, 2007; Tyler et al., 2008). Such a cooperative spirit is epitomized by the Zulu word *ubuntu,* which reflects the belief that people become fully human largely through caring relationships with others and regular contributions to the common good.

Students from cooperative cultures may resist when asked to compete against their classmates, as 16-year-old Maria explains:

> I love sports, but not competitive sports. [My brother is] the same way. I think we learned that from our folks. They both try to set things up so that everyone wins in our family and no one is competing for anything. (Pipher, 1994, p. 280)

Students may also be confused when teachers reprimand them for helping one another on assignments or for sharing answers, and they may feel uncomfortable when their individual achievements are publicly acknowledged. Group work, with an emphasis on cooperation rather than competition, often facilitates the school achievement of these students (Deyhle & Margonis, 1995; Lipka, 1998; L. S. Miller, 1995; Rogoff, 2003).

FAMILY RELATIONSHIPS AND EXPECTATIONS

In many groups—for example, in many Hispanic, Native American, Arab American, Polynesian, and Asian groups, as well as in some rural European American communities—family bonds and relationships are especially important, and extended family members often live nearby. Students growing up in these cultures are likely to feel responsibility for their family's well-being, to have a strong sense of loyalty to other family members, and to go to great lengths to please their elders. It isn't unusual for students in such communities to leave school when their help is needed at home, as Jack does in the opening case study (Banks & Banks, 1995; Fuligni, 1998; Kağitçibaşi, 2007; McIntyre, 2010).

In most cultures school achievement is highly valued, and parents encourage their children to do well in school (Monzó, 2010; R. R. Pearce, 2006; Spera, 2005). But some cultural groups place even higher priority on other accomplishments. For example, when preparing young children for school, many Hispanic families place particular emphasis on instilling appropriate social behaviors—for instance, showing respect for adults and cooperating with peers (Greenfield et al., 2006; Tyler et al., 2008). And in some cultural groups, an early pregnancy is a cause for joy even if the mother-to-be is young or hasn't yet completed high school (Deyhle & Margonis, 1995; McMichael, 2013; Stack & Burton, 1993).

We must certainly be sensitive to situations in which the achievements that *we* think are important are seemingly not valued by students' families. Whenever possible, we must show our students how the school curriculum and classroom activities relate to their cultural environment and their own life goals (Brayboy & Searle, 2007; Lipman, 1995; Moje & Hinchman, 2004). We must also maintain open lines of communication with students' parents. Because some parents of minority-group children feel intimidated by school personnel, teachers often need to take the first step in establishing productive parent–teacher relationships. When teachers and parents realize that both groups want students to succeed in the classroom, they're more apt to work cooperatively to promote student achievement (Anderman & Anderman, 2014; Edwards & Turner, 2010;

CONCEPTIONS OF TIME

Many people regulate their lives by the clock: Being on time to appointments, social engagements, and the dinner table is important. This emphasis on punctuality isn't characteristic of all cultures, however. For example, many Hispanic and Native American groups don't observe strict schedules and timelines (Tyler et al., 2008; Ward et al., 2001). Not surprisingly, children from these communities may sometimes be late for school and may have trouble understanding the need to complete school tasks within a certain time frame.

In most Western cultures, we tend to emphasize thinking about future time—what we will do tomorrow, our plans for next summer, or our goals for the next 10 years. Nevertheless, not all cultures emphasize future time; we need to be aware that some of our students may be less focused on the future than are others. For example, results of studies of individuals who speak Arabic indicate that an orientation toward the past is more prominent than an orientation toward the future (de la Fuente, Santiago, Román, Dumitrache, & Casasanto, 2014). Thus students from some cultural or linguistic backgrounds may tend to talk about and value the past more than do other students.

To succeed in mainstream Western society, students eventually need to learn punctuality. At the same time we must recognize that not all students will be especially concerned about clock time when they first enter our classrooms. Certainly we should expect students to come to class on time and to turn in assignments when they're due. But we must be patient and understanding when, for cultural reasons, students don't develop such habits immediately.

WORLDVIEWS

The cultural and ethnic differences identified so far reveal themselves, in one way or another, in students' behaviors. Yet the definition of culture presented early in the chapter includes the behaviors *and belief systems* that characterize a social group. Our general beliefs and assumptions about the world—collectively known as our worldview—are often so integral to our everyday thinking that we take them for granted and aren't consciously aware of them (Koltko-Rivera, 2004; Losh, 2003). Some beliefs that permeate the curriculum in traditional Western schools aren't universally shared, however. Consider the following examples:

- After a major hurricane ripped through their community, many fourth and fifth graders attributed the hurricane to natural causes, but some children from minority-group backgrounds had heard explanations elsewhere that led them to believe that people's actions or supernatural forces also played a role in the hurricane's origins and destructiveness (O. Lee,
- Fourth graders from the Menominee culture (a Native American group) often show exceptionally high achievement scores in science, but by eighth grade their scores may decline considerably. Menominee culture encourages children to think about the many ways in which they are a *part* of nature, rather than taking care of or dominating it, and children increasingly find the school science curriculum at odds with this view (Atran, Medin, & Ross, 2005; Medin, 2005).
- When American high school students read newspaper articles about the appropriateness or inappropriateness of prayer in public schools, some view the trend away from prayer as a sign of progress toward greater religious freedom. But others—those from deeply religious Christian families, for instance—view the same trend as a decline that reflects abandonment of the country's religious heritage (Mosborg, 2002).

As you can see, then, students' worldviews are likely to influence their interpretations of current events and classroom subject matter (Kağitçibaşi, 2007; Keil & Newman, 2008).

Gender Differences

In their academic abilities, boys and girls are probably more similar than you think. But in other respects they may be more different than you realize.

RESEARCH FINDINGS REGARDING GENDER DIFFERENCES

Researchers have identified a number of gender differences in the physical, cognitive, personal, and social domains.

PHYSICAL ACTIVITY AND MOTOR SKILLS

Generally, boys are temperamentally predisposed to be more active than girls. Thus, they have more trouble sitting still for long periods and are less likely to enjoy sedentary activities such as reading (W. O. Eaton & Enns, 1986; Newkirk, 2002). Before puberty, boys and girls seem to have similar *potential* for physical and psychomotor growth, although girls have a slight edge in fine motor skills (e.g., handwriting). But overall, boys develop their physical and motor skills more, perhaps through participation in organized sports (Eccles, 2005; J. R. Thomas & French, 1985). After puberty, boys have a biological advantage in height and muscular strength: They're taller and, because of increased levels of the male sex hormone testosterone, they're stronger (Halpern, 2006; Hyde, 2005; J. R. Thomas & French, 1985).

Such differences are hardly justification for favoring either gender when enhancing students' physical fitness, of course. Physical education curricula and sports programs should provide equal opportunities for boys and girls to maximize their motor skills and physical well-being.

COGNITIVE AND ACADEMIC ABILITIES

On average, boys and girls perform similarly on tests of general intelligence, in part because experts who construct the tests eliminate items that favor one group or the other (Halpern & LaMay, 2000). Researchers sometimes do find differences in more specific cognitive abilities, however. The most consistently observed gender difference is in visual–spatial ability, the ability to imagine and mentally manipulate two- and three-dimensional figures. As an example of what this ability involves, try the next exercise.

EXPERIENCE WITH TECHNOLOGY

As societies worldwide are gaining increasing access to computers and wireless technologies, boys and girls alike are becoming increasingly proficient with technology—for example, they're apt to stay in frequent contact with peers by texting and sending photographs on cell phones and by posting messages on social networking websites such as Facebook and Instagram (Greenhow, Robelia, & Hughes, 2009; Valkenburg & Peter, 2009). But overall, boys seem to spend more of their leisure time with technology than girls do. Boys are more likely to play video games, a pastime that may interfere with their reading and writing development but enhances their visual–spatial ability and probably also their comfort and expertise with computers (Feng, Spence, & Pratt, 2007; Ivory, 2006; Lucas & Sherry, 2004; Weis & Cerankosky, 2010). When using educational technology in school, boys may be more confident initially because they may have had more experience using similar technology; however, girls adapt well and generally benefit equally from educational technology (Nietfeld, Shores, & Hoffmann, 2014).

MOTIVATION IN ACADEMIC ACTIVITIES

On average, girls are more concerned about doing well in school: They're more engaged in classroom activities, more diligent in completing school assignments, and more likely to graduate from high school (H. M. Marks, 2000; Marsh, Martin, & Cheng, 2008; McCall, 1994; J. P. Robinson & Lubienski, 2011). Furthermore, girls are more interested in getting a college education than are boys, and in many countries more females than males earn college degrees (Halpern et al., 2007; National Science Foundation, 2007). However, this eagerness to achieve academically leads girls to prefer tasks at which they know they can succeed, and some find academic failure devastating. On average, boys are more willing to take on academic challenges and risks and more likely to take their failures in stride (Dweck, 2000; Yu, Elder, & Urdan, 1995).

SENSE OF SELF

Beginning in the upper elementary or middle school grades, boys appear to have a slightly more positive sense of self than do girls. This gender difference seems to be partly due to boys' tendency to *over*estimate their abilities and possibly also to girls' tendency to *under*estimate theirs (Hyde, 2007; Lundeberg & Mohan, 2009; Pajares, 2005). Boys' and girls' self-perceptions also tend to be consistent with stereotypes about what males and females are good at, especially in adolescence. Boys tend to rate themselves more highly in mathematics and sports, whereas girls tend to rate themselves more highly in reading and social studies. Such differences in self-perceptions persist even when boys' and girls' actual ability levels are *equal* (D. A. Cole, Martin, Peeke, Seroczynski, & Fier, 1999; Herbert & Stipek, 2005; Leaper & Friedman, 2007; Wigfield, Byrnes, & Eccles, 2006).

INTERPERSONAL BEHAVIORS AND RELATIONSHIPS

One of the most consistently observed gender differences involves aggression. In early childhood and throughout the elementary and secondary school years, boys are more physically aggressive than girls, with the difference being especially large for *unprovoked* aggression (Card, Stucky, Sawalani, & Little, 2008; Hyde, 2007; Pellegrini, 2011). However, girls can be equally aggressive in a nonphysical way—for instance, by spreading rumors or snubbing peers (Crick, Grotpeter, & Bigbee, 2002; French, Jansen, & Pidada, 2002; Pellegrini & Archer, 2005). Some of their victims can be emotionally devastated by such treatment (Rudolph, Caldwell, & Conley, 2005). Girls also may be more likely than boys to engage in cyberbullying by using the Internet (Connell, Schell-Busey, Pearce, & Negro, 2013).

Consistent differences are also seen in boys' and girls' interpersonal activities and relationships. Boys tend to congregate in large groups that engage in rough-and-tumble play, organized group games, and physical risk-taking activities (Maccoby, 2002; Pellegrini, Kato, Blatchford, & Baines, 2002; A. J. Rose & Smith, 2009). They enjoy competition and can be fairly assertive in their efforts to achieve their goals (Benenson et al., 2002; Eisenberg, Martin, & Fabes, 1996; Maccoby, 2002). They may often try to hide their true emotions in social situations, putting up a tough, "nothing-can-bother-me" front (Lippa, 2002; Pollack, 2006).

Whereas boys are apt to be competitive, girls are more likely to be affiliative and cooperative. Thus, they tend to form closer relationships with their teachers and to achieve at higher levels when classroom activities involve cooperation rather than competition (Inglehart, Brown, & Vida, 1994; Wentzel, Battle, Russell, & Looney, 2010). When working with instructional software, girls like to form relationships with their virtual "teachers," and those relationships, even though they are with a computer-generated character, may help to improve attitudes and motivation in subjects such as mathematics (Kim & Lim, 2013). Girls also seem to be more attuned to others' mental states and more sensitive to the subtle, nonverbal messages—the body language—that others communicate (Bosacki, 2000; Deaux, 1984). Girls spend much of their leisure time with one or two close friends, with whom they may share their innermost thoughts and feelings (Leaper & Friedman, 2007; A. J. Rose & Smith, 2009). Although girls can be assertive in making their wishes known, they're also concerned about resolving conflicts and maintaining group harmony, and so they may sometimes subordinate their own needs to those of others (Benenson et al., 2002; Leaper & Friedman, 2007; Rudolph et al., 2005).

CLASSROOM BEHAVIORS

In part because boys tend to be physically more active than girls, they're more likely to misbehave in class (Altermatt, Jovanovic, & Perry, 1998; Gay, 2006; Sadker & Sadker, 1994). Boys talk more and ask more questions, sometimes without waiting to be called on. They also tend to dominate small-group discussions and work sessions. Girls are more reticent classroom participants. They're less likely to publicly volunteer ideas and ask questions, perhaps for fear of looking stupid or perhaps because they worry that looking too smart will reduce their popularity (Jovanovic & King, 1998; Sadker & Sadker, 1994; Théberge, 1994; Wentzel, 2009). Girls are more likely to express their opinions in small-group rather than large-group discussions, and they're more likely to assume the role of leader (thereby developing valuable leadership skills) in same-sex groups (Fennema, 1987; MacLean, Sasse, Keating, Stewart, & Miller, 1995; Théberge, 1994).

CAREER ASPIRATIONS

Historically, boys have had more ambitious career aspirations than girls have. In recent years, however, many girls—especially those in Western countries—have also begun to set their sights on challenging professions. Often, boys and girls alike focus on careers that are stereotypically "appropriate" for their gender, in part because they have greater self-confidence about their ability to succeed in such careers (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Leaper & Friedman, 2007; Weisgram, Bigler, & Liben, 2010). Students' general life goals come into the picture as well: Girls are more likely than boys to consider how their career choices might mesh with their desires to work with people (rather than objects) and to raise a family (Diekman, Brown, Johnston, & Clark, 2010; Eccles, 2009).

Some gender differences are especially prevalent for particular age-groups. Table 4.1 identifies differences you're apt to see at various grade levels and offers relevant classroom strategies for accommodating these differences.

ORIGINS OF GENDER DIFFERENCES

Obviously, heredity determines basic physical differences between males and females; some are present at birth, some emerge at puberty. And because of inherited differences in sex-related hormones—especially estrogen for girls and testosterone for boys—girls reach puberty earlier and boys eventually become taller and stronger. Hormones may account for certain nonphysical gender differences as well. The gender difference in physical aggression appears to be related to testosterone levels (Lippa, 2002; S. Moore & Rosenthal, 2006). Hormones may also play a role in the small differences observed in visual–spatial and verbal abilities, possibly by affecting neurological development in different areas of the brain (Valla & Ceci, 2011; Vuoksimaa et al., 2010). Hormones even seem to influence children's preferences for male-stereotypical versus female-stereotypical behaviors (Auyeung et al., 2009; Hines et al., 2002).

Yet environmental factors clearly play a role as well, often by interacting with and amplifying existing biology-based gender differences (Lippa, 2002; Nuttall, Casey, & Pezaris, 2005). Virtually every culture teaches children that some behaviors are more appropriate for males and others more appropriate for females, as the following exercise may show you.

EXPERIENCING FIRSTHAND

PICTURE THIS #2

Form a picture in your mind of each of the following individuals. Make note of the *first* image that comes to mind in each case:

Secretary	Scientist
Bank president	Fashion model
Elementary school teacher	Building contractor

Which individuals did you picture as male, and which did you picture as female?

As young children become increasingly aware of the typical characteristics and behaviors of boys, girls, men, and women, they gradually pull their knowledge together into self-constructed understandings, or gender schemas, of how males and females are different. These gender schemas, in turn, become part of their sense of self and guide them in their choices and behaviors. By the time children reach school age, much of the pressure to act "appropriately" for their gender comes from within rather than from others (Bem, 1981; Eccles, 2009; Ruble, Martin, & Berenbaum, 2006).

Because gender schemas are self-constructed, their contents vary considerably from one individual to another (Liben & Bigler, 2002). For example, in adolescence some girls incorporate into their "female" schema unrealistic standards of beauty presented in popular media (films, fashion magazines, Internet sites, etc.). As girls compare themselves to these standards, they almost invariably come up short, and their self-assessments of physical attractiveness decline. In an effort to achieve the super-thin bodies they believe to be ideal, they may fall victim to eating disorders (Attie, Brooks-Gunn, & Petersen, 1990; Weichold, Silbereisen, & Schmitt-Rodermund, 2003). Likewise, some teenage boys go out of their way to meet self-constructed macho standards of male behavior by putting on a tough-guy act at school and bragging (perhaps accurately, but more often not) about their many sexual conquests (Pollack, 2006; K. M. Williams, 2001a).

Not all students have rigid or unrealistic stereotypes of what their gender should be like, of course. In fact, as students get older, many become increasingly flexible about what males and females can and should do. Those with more flexible gender schemas are more likely to pursue counterstereotypical interests and career paths (Liben & Bigler, 2002; C. L. Martin & Ruble, 2004).

MAKING APPROPRIATE ACCOMMODATIONS FOR GENDER DIFFERENCES

Despite many teachers' best intentions to treat male and female students equitably, subtle inequities continue. For example, teachers tend to give more attention to boys, partly because boys ask more questions and present more discipline problems. Teachers give boys more feedback—praise and criticism alike—than they give girls (Altermatt et al., 1998; Eisenberg et al., 1996; Gay, 2006; Halpern et al., 2007; S. M. Jones & Dindia, 2004). Teachers also tend to overestimate boys' abilities and underestimate girls' abilities in some subject areas, such as math (American Friends of Tel Aviv University, 2015).

The Into the Classroom feature "Promoting Gender Equity" offers several general suggestions for equitably fostering the learning and development of both sexes. At the same time, gender differences sometimes *do* warrant differential treatment of girls and boys. For example, girls are likely to improve their visual–spatial ability if we give them frequent opportunities to engage in activities requiring visual–spatial thinking (B. M. Casey et al., 2008; Gallagher & Kaufman, 2005). Girls also are more likely to benefit from computer software used during mathematics instruction when such programs include female characters and when those programs provide help options for users (Arroyo, Burleson, Tai, Muldner, & Woolf, 2013). Meanwhile, boys are more likely to improve their literacy skills if we allow them to pursue typical "boy" interests (e.g., sports, adventure) while reading and writing (Newkirk, 2002). In recent years, some educators have advocated for single-sex schools.

Although there may be some social benefits to such settings, however, math and science achievement do not appear to be affected by attending a single-sex school (Pahlke, Hyde, & Mertz, 2013).

We must also help students recognize that gender stereotypes are just that—*stereotypes*—and don't necessarily limit what males and females can or should be. For example, we can:

- Expose students to same-gender adults and peers who excel in domains commonly associated with the opposite gender.
- Talk about the importance of all academic subject areas for students' future success.
- Explain the historical roots of stereotypes. For instance, explain that differing expectations for males and females are a holdover from an era when many jobs outside the home required considerable strength (and thus were better suited for men) and jobs inside the home could easily be combined with breast-feeding (and thus were better suited for women).
- Engage students in discussions about the adverse consequences of rigid gender roles—noting, for example, that adhering to such roles limits people's options and results in a lot of talent going to waste. (Bem, 1983, 1984; Evans-Winters & Ivie, 2009; Fennema, 1987; Huguet & Régner, 2007; A. Kelly & Smail, 1986; Pollack, 2006)

MyEdLab **Self-Check 4.2**

MyEdLab **Application Exercise 4.3.** In this interactive exercise you can practice identifying strategies for accommodating gender differences in the classroom.

Socioeconomic Differences

The concept of **socioeconomic status (SES)** encompasses a number of variables, including family income, parents' education levels, and parents' occupations. A family's socioeconomic status—whether high-SES, middle-SES, or low-SES—gives us a sense of family members' standing in the

community: what type of neighborhood they live in, how much influence they have on political decision making, what educational opportunities are available to them, what resources they have available in their homes, and so on.

Students' school performance is correlated with their socioeconomic status: Higher-SES students tend to have higher academic achievement, and lower-SES students tend to be at greater risk for dropping out of school (J.-S. Lee & Bowen, 2006; Sirin, 2005; Tucker-Drob, 2013). As students from lower-SES families move through the grade levels, they tend to fall further and further behind their higher-SES peers (American Psychological Association, 2012; Farkas, 2008; Jimerson, Egeland, & Teo, 1999). Lower-SES students often live in neighborhoods with fewer economic and educational resources, both of which contribute to lower achievement for these students (Dupere, Leventhal, Crosnoe, & Dion, 2010). When researchers find achievement differences among students from different ethnic groups, the differences in the students' socioeconomic status—*not* their cultural differences—seem to be mostly to blame (Byrnes, 2003; N. E. Hill, Bush, & Roosa, 2003; Murdock, 2000).

Life certainly isn't perfect for students from high-SES homes (Luthar, 2006; Luthar & Latendresse, 2005). Some high-income parents have such high expectations for their children's achievement that the children suffer from significant anxiety and depression. In addition, some high-income parents have demanding jobs that keep them both physically and emotionally distant from their children, thereby limiting the guidance and support they provide. But by and large it's children who live in poverty, especially *chronic* poverty, who face the most significant obstacles to academic success and personal well-being.

EXPERIENCING FIRSTHAND
HOMEWORK ON THE INTERNET

Imagine that you are teaching fifth grade in an elementary school that has adopted a fully online mathematics program. Your school has adequate technology resources, and your students are able to work on computers in school every day. In addition, all of the homework assignments are completed online.

Cindy, a student in your class, approaches you and says "I don't have Internet at home." She then adds, "I don't even have a computer; my family says we can't afford one."

What should you do?

Unfortunately, this situation is not uncommon. As more schools are adopting curricula that are only provided online, access to the Internet is becoming essential. Nevertheless, students from low-SES neighborhoods are less likely to have this access. For some families, the only alternative is to take their children to local libraries to do their homework, and use computers that are available at those locations. Nevertheless, having to take a child to a library every night to do homework may be very stressful, particularly for parents who also work full time or do not have transportation. As teachers, we can provide students like Cindy with alternative resources. For example, we can print out the assignments for these students and send home paper copies.

CHALLENGES ASSOCIATED WITH POVERTY

Many, many children grow up in poverty, including more than *16 million* children (22%) in the United States (U.S. Census Bureau, 2010). Some of these children live in inner-city neighborhoods, but others live in rural areas or in modest apartments in wealthy suburbs. Some come from families that can meet life's basic necessities (e.g., food, warm clothing, adequate shelter) but have little money left over for luxuries. Many others live in extreme poverty; these students are the ones most at risk for academic failure and thus most in need of our attention and support.

Several factors tend to contribute to the generally lower school achievement of low-SES students. Students who face only one or two of these challenges often do quite well in school, but those who face many or all of them are at high risk for academic failure and other negative outcomes (Becker & Luthar, 2002; Gerard & Buehler, 2004; Grissmer, Williamson, Kirby, & Berends, 1998).

Poor nutrition and health. Lower-income families have fewer financial resources to ensure that their children have adequate nutrition and health care. Poor nutrition in the early years

of life (including the 9 months before birth) can lead to impairments in children's attention, memory, and learning ability (Aboud & Yousafzai, 2015; Noble, Tottenham, & Casey, 2005). Poor nutrition seems to influence school achievement both directly—for example, by hampering early brain development—and indirectly—for example, by leaving children listless and inattentive in class (Ashiabi & O'Neal, 2008; Sigman & Whaley, 1998). And inadequate health care means that some conditions that interfere with school attendance and performance, such as asthma and hearing problems, go unaddressed (Berliner, 2005).

Inadequate housing and frequent moves. Many poor children live in tight quarters, perhaps sharing one or two rooms with several other family members (Hawkins, 1997; Hernandez, Denton, & Macartney, 2008). Furthermore, children who move frequently from one rental apartment to another must often change schools as well. In the process they lose existing social support networks—both with teachers and with peers—and may miss lessons on fundamental academic skills (Croninger & Valli, 2009; Gruman, Harachi, Abbott, Catalano, & Fleming, 2008; Hattie, 2009).

Exposure to toxic substances. Especially when children live in poor, inner-city neighborhoods, their surroundings may expose them to excessive levels of environmental toxins that can seriously jeopardize their health and brain development (Hubbs-Tait, Nation, Krebs, & Bellinger, 2005; Koger, Schettler, & Weiss, 2005). For example, in old, badly maintained apartment buildings, children may be exposed to lead in the dust from deteriorating paint. In addition, the city water supply may contain pesticides or industrial waste, and the local air may be polluted by power plants and industrial incinerators.

Unhealthy social environments. On average, low-SES neighborhoods and communities have higher frequencies of violence and vandalism, greater prevalence of alcoholism and drug abuse, and greater numbers of antisocial peers. Furthermore, there are fewer productive outlets for leisure time—libraries, recreation centers, sports leagues, and so on—and fewer positive adult role models. Such factors appear to be partly responsible for the lower academic achievement of students who live in poverty (Aikens & Barbarin, 2008; T. D. Cook, Herman, Phillips, &

Emotional stress. Students at all income levels experience stressful conditions at one time or another, but students from low-income families have more than their share. On average, low-SES homes are more chaotic and unpredictable than affluent ones. Children may wonder where their next meal is coming from or when the landlord might evict them for not paying rent. The preponderance of single-parent homes among low-SES families can come into play as well: A single parent may be too distracted by personal problems to offer much affection or consistent discipline. As a result of such factors, students from low-SES families show higher-than-average rates of depression and other emotional problems (Crosnoe & Cooper, 2010; G. W. Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Foulds, Wells, & Mulder, 2014; Morales & Guerra, 2006; Parke et al., 2004). Sometimes, too, chronic stress adversely affects students' physical development, which in turn can hamper their cognitive development (G. W. Evans & Schamberg, 2009).

Not all children from low-income homes live in chronically stressful conditions, of course, and those whose families provide consistent support, guidance, and discipline generally enjoy good mental health (N. E. Hill et al., 2003; M. O. Wright & Masten, 2006). Nevertheless, we should continually be on the lookout for signs that certain students are experiencing unusual stress at home and then provide whatever support we can. In some instances effective support may involve nothing more than being a willing listener. In other cases we may want to consult with a school counselor, school psychologist, or social worker about possible support systems at school and resources in the local community.

Gaps in background knowledge. Some students from low-SES families lack the basic knowledge and skills (e.g., knowledge of letters and numbers) on which successful school learning so often depends (Aikens & Barbarin, 2008; Brooks-Gunn, Linver, & Fauth, 2005; Siegler, 2008).

Access to early educational opportunities that might foster such skills—books, computers, trips to zoos and museums, and so on—is always somewhat dependent on a family's financial resources. In addition, some parents have few basic academic skills that they might share with their children. However, as always, we must be careful not to overgeneralize. Some low-income parents have considerable education (perhaps a college degree) and may be well equipped to read to their children and provide other enriching educational experiences (Goldenberg, 2001; Raikes et al., 2006; Sidel, 1996).

Lower-quality schools. Unfortunately, the students who most need good schools are often least likely to have them. Schools in low-income neighborhoods and communities tend to receive less funding and, as a result, are often poorly equipped and maintained. Teacher turnover rates are high in these schools, and disciplinary tactics tend to be more harsh and less effective. Furthermore, some teachers at these schools have low expectations for students, offering a less-challenging curriculum, assigning less homework, and providing fewer opportunities to develop advanced thinking skills than do teachers in wealthier school districts (G. W. Evans, 2004; McLoyd, 1998; Pianta & Hamre, 2009; Raudenbush, 2009).

FOSTERING RESILIENCE

Thanks in part to teachers like Miss A, many students of low-income families succeed in school despite exceptional hardships. Some are resilient students who acquire characteristics and coping skills that help them rise above their adverse circumstances. As a group, resilient students have likable personalities, a positive sense of self, and ambitious goals, and they believe that success comes with hard work and a good education (S. Goldstein & Brooks, 2006; Schoon, 2006; Werner & Smith, 2001).

WORKING WITH HOMELESS STUDENTS

Children of homeless families typically face far greater challenges than other students from low-income families. Many have chronic physical problems, limited social support networks, significant mental health issues, and inappropriate behaviors. Some may be reluctant to come to school because they lack bathing facilities and suitable clothing, and some may even be runaways. Others may have moved so frequently from one school to another that they have large gaps in their academic skills (Coe, Salamon, & Molnar, 1991; McLoyd, 1998; P. M. Miller, 2011; Polakow, 2007).

Students at Risk

Students at risk are those with a high probability of failing to acquire the minimum academic skills necessary for success in the adult world. Many students at risk drop out before high school graduation, and many others graduate without mastery of basic skills in reading or mathematics (e.g., Boling & Evans, 2008; Laird, Kienzl, DeBell, & Chapman, 2007; U.S. Department of Education, 2015). Some students are at risk for dropping out of school earlier than are others. Results of a national study of students who were in the ninth grade during the 2009 academic year indicated that 2.7% of those students had dropped out of high school by the time they should have been in the 11th grade.

A common assumption is that the reasons for dropping out lie primarily in the students themselves (V. E. Lee & Burkam, 2003). But as we will see, school characteristics also play a significant role.

Some schools have been referred to as "dropout factories" (American Psychological Association, 2012). These schools have extraordinarily high dropout rates, and many are in areas of high poverty. Data suggest that in the United States, there are about 2,000 high schools in which the ninth-grade class decreases by at least 40% by the time those students should be high school seniors (Balfanz & Legters, 2004).

CHARACTERISTICS OF STUDENTS AT RISK

Students at risk come from all socioeconomic levels, but children of poor, single-parent families are especially likely to leave school before high school graduation. Boys are more likely than girls to drop out, and African Americans, Hispanics, and Native Americans are more likely than European American and Asian American students to drop out. Also, students in large cities and rural areas are more likely to drop out than students in the suburbs are; graduation rates in some big cities are less than 40% (C. Chapman, Laird, & KewalRamani, 2010; Hardré & Reeve, 2003; L. S. Miller, 1995; National Research Council, 2004).

Students at risk, especially those who eventually drop out, typically have some or all of the following characteristics:

- *A history of academic failure.* On average, students who drop out have poorer reading and study skills, achieve at lower levels, have less confidence in their academic ability, and are more likely to have repeated a grade than their classmates who graduate. Consistent patterns of low achievement are sometimes seen as early as third grade (Christle, Jolivette, & Nelson, 2007; Fan & Wolters, 2012; Hattie, 2009; Korhonen, Linnanmäki, & Aunio, 2014; Suh, Suh, & Houston, 2007).

- *Emotional and behavioral problems*. Potential dropouts tend to have lower self-esteem than their more successful classmates. They're also more likely to exhibit serious behavioral problems (e.g., fighting, substance abuse) both in and out of school. Often their close friends are low-achieving and, in some cases, antisocial peers (Battin-Pearson et al., 2000; Garnier, Stein, & Jacobs, 1997; Jozefowicz, Arbreton, Eccles, Barber, & Colarossi, 1994; Suh et al., 2007).
- *Lack of psychological attachment to school*. Students at risk for academic failure are less likely to identify with their school or to perceive themselves as being a vital part of the school community. For example, they engage in few extracurricular activities and are apt to express dissatisfaction with school in general (Christenson & Thurlow, 2004; Hymel, Comfort, Schonert-Reichl, & McDougall, 1996; Rumberger, 1995).
- *Increasing disengagement with school*. Dropping out isn't necessarily an all-or-nothing event. Many high school dropouts show lesser forms of dropping out many years before they officially leave school. Future dropouts are absent from school more frequently than their peers, even in the elementary grades. In addition, they're more likely to have been suspended from school and to show a long-term pattern of dropping out, returning to school, and dropping out again (Christenson & Thurlow, 2004; Suh et al., 2007).

The characteristics just described certainly aren't surefire indicators of which students will drop out, however. For example, some dropouts come from two-parent, middle-income homes, and some are actively involved in school activities almost until the time they drop out (Hymel et al., 1996; Janosz, Le Blanc, Boulerice, & Tremblay, 2000).

WHY STUDENTS DROP OUT

Students drop out for a variety of reasons. Some have little family and peer encouragement and support for school success. Others have extenuating life circumstances; perhaps they have medical problems, take a job to help support the family, become depressed, or get pregnant. Many simply become dissatisfied with school: They find the school environment unwelcoming or dangerous, perceive the curriculum to be boring and personally irrelevant, become victims of teasing or bullying, are absent often, or doubt that they can pass the high-stakes achievement tests on which graduation depends (Balfanz, Herzog, & Mac Iver, 2007; Brayboy & Searle, 2007; Cornell, Gregory, Huang, & Fan, 2013; Hardré & Reeve, 2003; Hursh, 2007; Quiroga, Janosz, Bisset, & Morin, 2013).

Sadly, teacher behaviors can enter into the picture as well. For example, a teacher might communicate low expectations for students' achievement either explicitly (e.g., by telling them that their chances of earning passing grades are slim) or implicitly (e.g., by brushing off their requests for assistance on assigned tasks). Students are more likely to drop out when they perceive their teachers to be uninterested in helping them succeed (Becker & Luthar, 2002; Farrell, 1990; Suh et al., 2007).

SUPPORTING STUDENTS AT RISK

Because students who are at risk for academic failure are a diverse group of individuals with a diverse set of needs, there is no single strategy that can keep all of them in school until high school graduation (Christenson & Thurlow, 2004; Janosz et al., 2000). Nevertheless, effective school and classroom practices will go a long way in helping these students stay on the road to academic success and high school graduation. Following are several suggestions based on research findings.

Islamic Online University
Lecture Notes for Modules 9 & 10

TEXTBOOK CHAPTER 5: INDIVIDUAL DIFFERENCES AND SPECIAL EDUCATIONAL NEEDS

LEARNING OUTCOMES

1 Describe various perspectives on the nature of intelligence, and identify several ways in which you can nurture intelligence in your own students.
2 Explain how students' cognitive styles and dispositions might influence their classroom performance.
3 Explain how you might adapt your instruction and classroom practices to the unique strengths and limitations of students with various disabilities.
4 Explain how you might nurture the development of students who show exceptional gifts and talents.

CASE STUDY: TIM

In elementary school, Tim earned reasonable grades despite poor reading comprehension skills. Although he often appeared to be in a daze during classroom activities, he was generally well behaved. In middle school his grades began to decline, and teachers complained of his spaciness and tendency to daydream. He had trouble staying on task in class and was so disorganized that he seldom completed homework. When Tim reached high school, he seemed unable to cope with the independence his teachers expected of students, and so he failed several 9th- and 10th-grade classes.

Now, as a 17-year-old 11th grader, Tim undergoes an in-depth psychological evaluation at a university diagnostic clinic. An intelligence test yields a score of 96, reflecting average ability, and measures of social and emotional adjustment are also within an average range. However, measures of attention consistently show this to be an area of weakness. Tim explains that he has trouble ignoring distractions and must find a very quiet place to do his schoolwork. Even then, he says, he often has to reread something several times to grasp its meaning. (Based on Hathaway, Dooling-Litfin, & Edwards, 2006, pp. 410–412)

- Tim's attention problems have obviously been interfering with his academic achievement. But if you look closely at the facts presented in the case, you might realize that Tim also has strengths on which teachers can build. What particular characteristics might be working in Tim's favor?
- As a teacher, how might you adapt your instructional strategies and classroom environment to accommodate Tim's unique needs?

Case Study Analysis

Tim

As a teacher, what strategies might you use to accommodate Tim's unique needs?

Useful strategies include: helping the student locate a quiet place to read and study; teaching organizational skills; breaking complex tasks into several shorter, simpler ones.

Additional question

Consider five general categories of special needs: specific cognitive and academic deficits, social and behavioral problems, general delays in cognitive and social functioning, physical and sensory challenges, and advanced cognitive development. In which of these categories does Tim fall? Can you guess the specific diagnosis that the clinic reached?

Tim's difficulty is primarily a cognitive one. He has good social skills and appropriate classroom behaviors. Therefore, he would fall in the first category of specific cognitive and academic deficits. The clinic diagnosis was attention-deficit hyperactivity disorder and specifically "ADHD, Predominantly Inattentive

The clinic evaluation team eventually concludes that Tim has attention-deficit hyperactivity disorder, or ADHD. (Like Tim, some students identified as having ADHD exhibit attention problems *without* hyperactivity.) The team suspects that a learning disability might be at the root of the problem but doesn't have sufficiently precise diagnostic techniques to determine this with certainty. On the plus side, Tim is certainly motivated to do well in school: He's well behaved in class, seeks out quiet places to study, and may read something several times in an effort to make sense of it. With appropriately modified instruction and settings—for example, teaching Tim basic organizational skills, breaking a single complex task into several shorter and simpler ones, and giving him a quiet place to read and study—Tim can more readily stay on task and complete assignments (Barkley, 2006; Meltzer, 2007).

Teachers have many diverse responsibilities, and meeting the needs of students like Tim may make prospective teachers feel somewhat anxious. As we will see, students show significant individual differences in cognitive abilities, personalities, physical skills, and so on. In this chapter we'll look at individual differences in intelligence, cognitive styles, and dispositions. We'll then consider *students with special needs*—students who, like Tim, are different enough from their peers that they require specially adapted curriculum materials, instructional practices, or both. As we go along, we'll find that the most effective instruction tends to be differentiated instruction—instruction that is tailored to align with each student's current knowledge, skills, and needs.

Intelligence

It is common for teachers, parents, and others to be involved in conversations about students' intelligence, and many of us use that term often. However, there are a variety of ways to talk about intelligence. As teachers, we need to be aware that this is a complex

topic. As we will discuss, measures of intelligence can be very useful, but overinterpretation of these scores can sometimes be harmful to our students. Theorists define and conceptualize *intelligence* in a variety of ways, but most agree that it has several distinctive qualities:

- It is *adaptive:* It can be used flexibly to respond to a variety of situations and problems.
- It is related to *learning ability:* People who are intelligent in particular domains learn new information and skills in those domains more quickly and easily than people who are less intelligent in those domains.
- It involves the *use of prior knowledge* to analyze and understand new situations effectively.
- It involves the complex interaction and coordination of *many different mental processes.*
- It is *culture specific.* What is considered to be intelligent behavior in one culture isn't necessarily intelligent behavior in another culture. (Dai, 2010; Laboratory of Comparative Human Cognition, 1982; J. Li, 2004; Neisser et al., 1996; Saklofske, van de Vijver, Oakland, Mpofu, & Suzuki, 2015; Sternberg, 1997, 2004, 2007; Sternberg & Detterman, 1986)

With these qualities in mind, we offer an intentionally broad definition of intelligence: the ability to apply prior knowledge and experiences flexibly to accomplish challenging new tasks.

For most theorists intelligence is somewhat different from what a person has actually learned (e.g., as reflected in school achievement). At the same time, intelligent thinking and behavior *depend* on prior learning. Intelligence, then, isn't necessarily a permanent, unchanging characteristic; it can be modified through experience and learning.

THEORETICAL PERSPECTIVES OF INTELLIGENCE

Some psychologists have suggested that intelligence is a single, general ability that people have to varying degrees and apply in a wide range of activities. Others have disagreed, citing evidence that people can be more or less intelligent on different kinds of tasks, at different points in development, and in different contexts. The theories of intelligence we examine in this section reflect these diverse perspectives on the nature of intelligence.

SPEARMAN'S CONCEPT OF *g*

Imagine that you give a large group of students a wide variety of tests—some measuring verbal skills, others measuring visual–spatial thinking, still others measuring mathematical problem solving, and so on. Chances are that the test scores would all correlate with one another to some degree: Students who score high on one test would tend to score high on the other tests as well. The correlations would be strong among tests of very similar abilities; those among tests of distinctly different abilities would be weaker. For example, a student who scored very high on a vocabulary test would probably score high on other measures of verbal ability but might have only modest success in solving math problems (McGrew, Flanagan, Zeith, & Vanderwood, 1997; Neisser et al., 1996; Spearman, 1904).

Charles Spearman (1904, 1927) drew on such findings to propose that intelligence comprises both (1) a single, pervasive reasoning ability (a *general factor*) that is used across the board and (2) a number of more specific abilities, such as problem-solving ability and abstract reasoning (*specific factors*). The general factor and any relevant specific factors work together during the execution of particular tasks.

Many contemporary psychologists believe that sufficient evidence supports Spearman's concept of a general factor in intelligence—often known simply as Spearman's **g**. Underlying it, they suspect, may be a general ability to process information quickly and efficiently (Bornstein et al., 2006; Coyle, Pillow, Snyder, & Kochunov, 2011; Haier, 2003). A general ability to control and direct one's thinking may also be involved (Cornoldi, 2010; H. L. Swanson, 2008).

CATTELL'S FLUID AND CRYSTALLIZED INTELLIGENCES

Several decades after Spearman's groundbreaking work, Raymond Cattell (1963, 1987) found evidence for two distinctly different components of general intelligence (*g*). First, people differ in **fluid intelligence**, their ability to acquire knowledge quickly, use abstract reasoning abilities, and adapt to new situations effectively. Second, they differ in **crystallized intelligence**, the knowledge and skills they've accumulated from their experiences, schooling, and culture. Fluid intelligence is more important for new, unfamiliar tasks, especially those that require rapid decision making and involve nonverbal content. Crystallized intelligence is more important for familiar tasks, especially those that depend heavily on language and prior knowledge. Cattell suggested that fluid intelligence is largely the result of inherited biological factors, whereas crystallized intelligence depends on both fluid intelligence and experience and thus is influenced by both heredity and environment.

EXPERIENCING FIRSTHAND
CRYSTALLIZED AND FLUID INTELLIGENCE

Consider the following two questions (Roberts & Lipnevich, 2012):

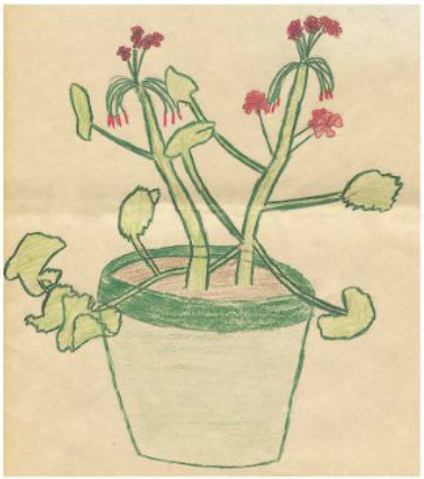
1. What is the next number in this sequence: 1 2 1 4 1 6 1 8?
2. What is the meaning of the word *peripatetic?*

One of these questions assesses fluid intelligence, whereas the other assesses crystallized intelligence. Can you tell which is which? Question 1 assesses fluid intelligence; a student has to reason abstractly to figure out the next number in the sequence; in contrast, question 2 represents crystallized intelligence, because knowledge of the meaning of the word *peripatetic* is something that a student would have learned—the answer could not be determined through any form of reasoning.[1] Both of these types of intelligence are important and valuable, but as you can see, they are also quite different.

CATTELL–HORN–CARROLL THEORY OF COGNITIVE ABILITIES

Keep in mind that different students are likely to be intelligent in different ways.

Some theorists have built on Cattell's distinction to suggest that intelligence may have three layers, or *strata* (Ackerman & Lohman, 2006; Carroll, 1993, 2003; D. P. Flanagan & Ortiz, 2001; Horn, 2008). In this *Cattell–Horn–Carroll theory of cognitive abilities,* the top stratum is general intelligence, or *g*. Underlying it in the middle stratum are 9 or 10 more specific abilities (including crystallized and fluid intelligence)—processing speed, general reasoning ability, general world knowledge, ability to process visual input, and so on—that encompass fluid and/or crystallized intelligence to varying degrees. And underlying *these* abilities in the bottom stratum are more than 70 very specific abilities, such as reading speed, mechanical knowledge, and number and richness of associations in memory. The Cattell–Horn–Carroll theory is the most researched and most widely accepted theory of intelligence among individuals who work with school-aged children and adolescents, and many of the IQ assessments currently in use are based on this theory (Kyllonen, 2015). The Cattell–Horn–Carroll theory is too complex to describe in detail here, but you should be aware that psychologists are increasingly finding it useful in predicting and understanding students' achievement in various content domains (e.g., J. J. Evans, Floyd, McGrew, & Leforgee, 2001; Phelps, McGrew, Knopik, & Ford, 2005; B. E. Proctor, Floyd, & Shaver, 2005; Proctor, 2012).



Attention to detail in 10-year-old Luther's drawing of a plant suggests some talent in what Gardner calls *naturalist* intelligence.

GARDNER'S MULTIPLE INTELLIGENCES

Howard Gardner (1983, 1999, 2011; Gardner & Hatch, 1990) suggests that people have at least eight distinctly different abilities, or *multiple intelligences,* that are relatively independent of one another (see Table 5.1). In his view there may also be a ninth (existential) intelligence dedicated to philosophical and spiritual issues (e.g., Who are we? Why do we die?). However, because evidence for it is weaker than that for the other intelligences (Gardner, 1999, 2000a, 2003), we have omitted it from the table.

Gardner presents some evidence to support the existence of these distinctly different intelligences. For instance, he describes people who are quite skilled in one area, perhaps in composing music, yet have seemingly average

TABLE 5.1 • Gardner's Multiple Intelligences

TYPE OF INTELLIGENCE	EXAMPLES OF RELEVANT BEHAVIORS
Linguistic intelligence: Ability to use language effectively	• Making persuasive arguments • Writing poetry or contributing to a blog • Noticing subtle nuances in meanings of words
Logical–mathematical intelligence: Ability to reason logically, especially in mathematics and science	• Solving mathematical problems quickly • Generating mathematical proofs • Formulating and testing hypotheses about observed phenomena[a]
Spatial intelligence: Ability to notice details of what one sees and to imagine and manipulate visual objects in one's mind	• Creating mental images • Manipulating mental images • Drawing a visual likeness of an object • Seeing subtle differences among visually similar objects
Musical intelligence: Ability to create, comprehend, and appreciate music	• Playing a musical instrument • Composing a musical work • Identifying the underlying structure of music
Bodily–kinesthetic intelligence: Ability to use one's body skillfully	• Dancing • Playing basketball • Performing pantomime
Interpersonal intelligence: Ability to notice subtle aspects of other people's behaviors	• Reading other people's moods • Detecting other people's underlying intentions and desires • Using knowledge of others to influence their thoughts and behaviors
Intrapersonal intelligence: Awareness of one's own feelings, motives, and desires	• Identifying the motives guiding one's own behavior • Using self-knowledge to relate more effectively with others
Naturalist intelligence Ability to recognize patterns in nature and differences among various life-forms and natural objects	• Identifying members of particular plant or animal species • Classifying natural forms (e.g., rocks, types of mountains) • Applying one's knowledge of nature in such activities as farming, landscaping, or animal training

[a]This example may remind you of Piaget's theory of cognitive development. Many of the stage-specific characteristics that Piaget described reflect logical–mathematical intelligence.
Sources: Gardner, 1983, 1999.

abilities in other areas. He also points out that people who suffer brain damage sometimes lose abilities that are restricted primarily to one intelligence. One person might show deficits primarily in language, whereas another might have difficulty with tasks that require spatial reasoning.

Among psychologists, reviews of Gardner's theory are mixed (Roberts & Lipnevich, 2012). Some theorists don't believe that Gardner's evidence is sufficiently compelling to support the notion of eight or nine distinctly different abilities (N. Brody, 1992; Corno et al., 2002; Sternberg, 2003; Waterhouse, 2006). Others agree that people may have a variety of relatively independent abilities but argue for different distinctions than those Gardner makes (e.g., note the second-stratum abilities in the Cattell–Horn–Carroll theory just described). Still others reject the idea that abilities in certain domains, such as in music or bodily movement, are really "intelligences" per se (Bracken, McCallum, & Shaughnessy, 1999; Sattler, 2001).

Despite researchers' lukewarm reception of Gardner's theory, many educators have wholeheartedly embraced it because of its optimistic view of human potential. Gardner's perspective encourages us to use many different teaching methods so that we can capitalize on students' diverse talents to help them learn and understand classroom subject matter (L. Campbell, Campbell, & Dickinson, 1998; Gardner, 2000b; Kornhaber, Fierros, & Veenema, 2004).

Whether or not human beings have eight or more distinctly different intelligences, they certainly benefit when they're encouraged to think about a particular topic in two or more distinctly different ways—perhaps using both words and mental images (R. E. Mayer, 2011b; Moreno, 2006). We won't always want to teach to students' strengths, however. We must also give students tasks that encourage them to address and thereby strengthen their areas of weakness (Sternberg, 2002).

STERNBERG'S THEORY OF SUCCESSFUL INTELLIGENCE

Robert Sternberg (e.g., 1998, 2004, 2012; Sternberg et al., 2000) has speculated that people may be more or less intelligent in three different domains. His Triarchic Theory of Intelligence (also sometimes referred to as the *Theory of Successful Intelligence*) focuses on how our skills and abilities

in these domains help us to achieve our short-term and long-term goals. *Analytical intelligence* involves making sense of, analyzing, contrasting, and evaluating the kinds of information and problems often seen in academic settings and on intelligence tests. *Creative intelligence* involves imagination, invention, and synthesis of ideas within the context of new situations. *Practical intelligence* involves applying knowledge and skills effectively to manage and respond to everyday problems and social situations. Sternberg has argued that traditional views of intelligence have focused too narrowly on academic success, and have neglected the role of intelligence in our everyday lives.

In addition, Sternberg proposes that intelligent behavior involves an interplay of three factors, all of which vary from one occasion to the next (Sternberg, 1985, 1997, 2003):

- *The environmental context in which the behavior occurs*. Different behaviors may be more or less adaptive and effective in different cultures. For example, learning to read is an adaptive response in industrialized societies yet largely irrelevant to certain other cultures.
- *The relevance of prior experiences to a particular task*. Prior experiences can enhance intelligence in either of two ways. In some cases extensive practice with a particular kind of task enables students to perform that task with increasing speed and efficiency—that is, with greater *automaticity*. For example, as children get more practice multiplying double-digit numbers (e.g., 32 × 55), their speed and efficiency at solving such problems increases. In other instances, students are able to draw on what they've learned in previous situations to help them with *new* tasks. For example, students may apply algebraic principles learned in math classes to problems in physical science.
- *The cognitive processes required by the task*. Numerous cognitive processes are involved in intelligent behavior: separating important information from irrelevant details, identifying possible problem-solving strategies, seeing relationships among seemingly different ideas, and so on. Different cognitive processes may be more or less important in different contexts, and an individual may behave more or less intelligently depending on the specific cognitive processes needed at the time.

There is some evidence that the three components of the theory of successful intelligence can be measured, and that assessments in these domains are related to important educational outcomes (Sternberg, 2010; Sternberg et al., 2014). In addition, recent research from the field of neuroscience suggests that similar processes are involved in creative and intellectual thinking (Silvia, 2015; Sternberg, 2003). However, empirical research supporting these three components is limited at this time (Roberts & Lipnevich, 2012). Nevertheless, the theory reminds us that students' ability to behave intelligently may vary considerably depending on the cultural context, previously learned knowledge and skills, and the cognitive processes that a task involves.

DEVELOPMENTAL VIEWS OF INTELLIGENCE

Theories of cognitive development portray children as becoming increasingly intelligent over time; for example, with age and experience children gain greater proficiency in abstract thinking (Jean Piaget's theory) and effective use of complex cultural tools (Lev Vygotsky's theory). Yet with the possible exception of Sternberg's triarchic theory—which points out the importance of prior experiences—the perspectives of intelligence described so far don't really consider how intelligence might take different forms at different points in development (Dai, 2010).

Some psychologists working in the area of giftedness suggest that not only is intelligence somewhat specific to particular domains but also that its basic nature changes with age and experience. From this perspective, the developmental course of exceptional abilities and talents is as follows:

1. Initially (typically in childhood), people show exceptional *potential* in a certain domain, perhaps in reading, math, or music.
2. With appropriate instruction, guidance, and practice opportunities, people show exceptional *achievement* in the domain.
3. If people continue to pursue the domain and practice domain-specific tasks over a lengthy time period (typically into adulthood), they may eventually gain considerable *expertise and eminence*, to the point that their accomplishments are widely recognized (Dai, 2010; Subotnik, Olszewski-Kubilius, & Worrell, 2011).

In addition, increases in more general cognitive abilities are related to experiences such as school attendance, work experiences, and other life events (Kyllonen, 2015). Here, then, we see a very dynamic view of intelligence: Although its roots may be in certain natural endowments, over the long run intelligence requires both environmental nurturance and personal perseverance (Dai, 2010; Subotnik et al., 2011)

DISTRIBUTED INTELLIGENCE

Many psychologists are beginning to realize that not only does a supportive environmental context enhance people's intelligence over time, but in fact it can facilitate intelligent behavior in the here and now. People are far more likely to think and behave intelligently when they have assistance from their physical, cultural, and social environments—an idea that is sometimes called distributed intelligence (e.g., Hutchins, 1995; Pea, 1993; Perkins, 1995). People can "distribute" a challenging task—that is, they can pass some of the cognitive burden onto something or someone else—in at least three ways. First, they can use physical objects, especially technology (e.g., tablets, calculators, computers), to handle and manipulate large amounts of information. In particular, having a smartphone available virtually at any time and in any place affords students the opportunity to access information and various tools. Second, they can represent and think about the situations they encounter by using their culture's various symbolic systems—words, charts, diagrams, and so on—and other cognitive tools. And third, they can work with other people to explore ideas and solve problems—as we've often heard, two heads are (usually) better than one. In fact, when students work together on complex, challenging tasks and problems, they teach one another strategies and ways of thinking that can help each of them think even *more* intelligently on future occasions (Kuhn, 2001b; Palincsar & Herrenkohl, 1999; Slavin, 2011).

From a distributed-intelligence perspective, then, intelligence is a highly variable, context-specific ability that increases when appropriate environmental supports are available. It certainly isn't an immutable trait that learners "carry around" with them, nor is it something that can be easily measured and then summarized with one or more test scores. However, psychologists coming from other theoretical perspectives often *do* try to measure intelligence, as we'll see now.

IQ SCORES AND SCHOOL ACHIEVEMENT

Studies repeatedly show that performance on intelligence tests is correlated with school achievement. On average, children with higher IQ scores earn higher course grades, do better on standardized achievement tests, and complete more years of education (N. Brody, 1997; Duckworth, Quinn, & Tsukayama, 2012; Sattler, 2001). Data suggest that these tests are predictive of success in higher education as well (Kuncel & Hezlett, 2007).

It's important to keep three points in mind about this IQ–achievement relationship. First, intelligence doesn't necessarily *cause* achievement; it is simply correlated with it. Even though students with high IQs typically perform well in school, we cannot conclusively say that their high achievement is actually the result of their intelligence. Intelligence probably does play an important role in school achievement, but so, too, do many other factors—motivation, quality of instruction, family and neighborhood resources, peer-group expectations, and so on. Second, the relationship between IQ scores and achievement is an imperfect one, with many exceptions to the rule. For a variety of reasons, some students with high IQ scores don't perform well in the classroom, and others achieve at higher levels than we would predict from their IQ scores alone. For example, recent research suggests that the relation between intelligence and achievement is affected by sleep—when students do not get enough sleep on any given night, intelligence and achievement aren't as closely correlated as they might otherwise be (Erath, Tu, Buckhalt, & El-Sheikh, 2015). Third and most important, we must remember that an IQ score simply reflects a

NATURE AND NURTURE IN THE DEVELOPMENT OF INTELLIGENCE

Research tells us that heredity probably plays some role in intelligence. For instance, identical twins tend to have more similar IQ scores than nonidentical (fraternal) twins do, even when the twins are adopted at birth by different parents and grow up in different homes. This is *not* to say, however, that children inherit a single IQ gene that determines their intellectual ability. Rather, they probably inherit a variety of characteristics that in one way or another affect particular cognitive abilities and talents (O. S. P. Davis, Haworth, & Plomin, 2009; Horn, 2008; Kan, Wicherts, Dolan, & van der Maas, 2013; Kovas & Plomin, 2007).

Environmental factors influence intelligence as well, sometimes for the better and sometimes for the worse. Poor nutrition in the early years of development (including the 9 months before birth) leads to lower IQ scores, as does a mother's excessive use of alcohol during pregnancy (Neisser et al., 1996; Ricciuti, 1993; Sigman & Whaley, 1998). Moving a child from a neglectful, impoverished home environment to a more nurturing, stimulating one (e.g., through adoption) can result in IQ gains of 15 points or more (Beckett et al., 2006; Capron & Duyme, 1989; van IJzendoorn & Juffer, 2005). Effective, too, are long-term intervention programs designed to help children acquire basic cognitive and academic skills (e.g., F. A. Campbell & Burchinal, 2008; Kağitçibaşi, 2007). Even simply *going to school* has a positive effect on IQ scores (Ceci, 2003; Ramey, 1992), and attending an academically rigorous school may be particularly related to gains in intelligence, even during adolescence (Becker, Lüdtke, Trautwein, Köller, & Baumert, 2012). Furthermore, worldwide, there has been a slow but steady increase in people's performance on intelligence tests—a trend that is probably due to better nutrition, smaller family sizes, better schooling, increasing cognitive stimulation (through increased access to technology, reading materials, etc.), and other improvements in people's environments (Flynn, 2007; E. Hunt, 2008; Neisser, 1998).

CULTURAL AND ETHNIC DIVERSITY IN INTELLIGENCE

Historically, some ethnic groups in the United States have, *on average,* performed better than other ethnic groups on intelligence tests. Most experts agree that such group differences in IQ scores are probably due to differences in environment and, more specifically, to economic circumstances that affect the quality of prenatal and postnatal nutrition, availability of stimulating books and toys, access to educational opportunities, and so on (Brooks-Gunn, Klebanov, & Duncan, 1996; Byrnes, 2003; McLoyd, 1998). Furthermore, various groups have become increasingly *similar* in average IQ score in recent years—a trend that can be attributed only to more equitable environmental conditions (Dickens & Flynn, 2006; Neisser et al., 1996).

Yet it's important to note that different cultural groups have somewhat different views about what intelligence *is* and may therefore nurture somewhat different abilities in their children (Saklofske et al., 2015). Many people of European descent think of intelligence primarily as an ability that influences children's academic achievement and adults' professional success. In contrast, people in many African, Asian, Hispanic, and Native American cultures think of intelligence as involving social as well as academic skills—maintaining harmonious interpersonal relationships, working effectively together to accomplish challenging tasks, and so on (Greenfield et al., 2006; J. Li & Fischer, 2004; Sternberg, 2004, 2007). In Buddhist and Confucian societies in the Far East (e.g., China, Taiwan), intelligence also involves acquiring strong moral values and making meaningful contributions to society (J. Li, 2004; Sternberg, 2003).

Cultural groups differ, too, in the behaviors that they believe reflect intelligence. For example, many traditional measures of intelligence take speed into account on certain test items: Children score higher if they respond quickly as well as correctly. Yet people in some cultures tend to value thoroughness over speed and may be skeptical when tasks are completed very quickly (Sternberg, 2007). As another example, many people in mainstream Western culture interpret strong verbal skills as a sign of intelligence, but for many Japanese and many Inuit people of northern Quebec, talking a lot indicates immaturity or low intelligence (Crago, 1988; Minami & McCabe, 1996; Sternberg, 2003). One Inuit teacher had this concern about a boy whose language was quite advanced for his age-group:

> Do you think he might have a learning problem? Some of these children who don't have such high intelligence have trouble stopping themselves. They don't know when to stop talking. (Crago, 1988, p. 219)

As teachers, then, we must be careful not to assume that our own views of intelligence are shared by the students and families of cultures very different from our own.

Cognitive Styles and Dispositions

Students with the same general level of intelligence often approach classroom tasks and think about classroom topics differently. Some of these individual differences reflect cognitive styles, over which students don't necessarily have much conscious control. Others reflect dispositions, which students voluntarily and intentionally bring to bear on their efforts to master school subject matter. Don't agonize over the distinction between the two concepts, because their meanings overlap considerably. Both involve not only specific cognitive tendencies but also personality characteristics (Furnham, 2012; Messick, 1994b; Zhang & Sternberg, 2006). Dispositions also have a motivational component—an I-*want*-to-do-it-this-way quality (Kuhn, 2001a; Perkins & Ritchhart, 2004; Stanovich, 1999).

DO STUDENTS HAVE DISTINCT LEARNING STYLES?

Over the past few decades, psychologists and educators have examined a wide variety of cognitive styles, sometimes instead using the term *learning styles*. You probably have heard of educators discussing students as perhaps being "visual learners" or "auditory learners." The notion behind learning styles is that if teachers adjust instruction to meet the favored learning styles of individual students, then learning will be enhanced. Thus, if a "visual learner" is provided with extra visual materials when learning about a new topic, that student's learning will be improved.

Despite the popularity of this idea among educators, there is virtually no evidence that adapting instruction to students' learning styles has any effect on their actual learning (Curry, 1990; R. E. Mayer & Massa, 2003; Nieto & Bode, 2008; Rogowsky, Calhoun, & Tallal, 2015; Roher & Pashler, 2012; Snider, 1990). Many of the styles that have been identified and assessment instruments that have been developed don't hold up under the scrutiny of researchers (Cassidy, 2004; Krätzig & Arbuthnott, 2006; Messick, 1994b). Learning "styles" are basically just preferences; some students may indicate that they prefer to learn through listening, whereas others may indicate that they prefer to learn visually. Nevertheless, these preferences are just that—preferences. It is not the case that students with one preferred style cannot learn just as well when information is presented in other ways.

In fact, adapting instruction to students' preferred learning styles, or even telling students that they may have a learning style, may prove to be detrimental to learning. Consider the following example:

> Harper is a sixth grader who does very well in school. On her mid-year report card, Harper's science teacher noted, "Harper does a great job in class; I just wish that she would participate more in our discussions." When Harper's parents asked her why she did not participate more in class, she responded that "the guidance counselor came in and gave us a test on our learning styles; she told me that I'm a visual learner. Since I am a visual learner, I don't really need to talk to learn; I just watch."

Why is this situation troubling? First, as we noted before, assessments of learning styles are generally not scientifically verified (and these "styles" are really just preferences). Second, and more disturbing, Harper has interpreted the information about being a visual learner as suggesting that she perhaps is weak in other areas, and thus does not need to learn with other modalities. If Harper is a quiet student, then we might recommend greater verbal interaction so that she can further develop her verbal skills; however, her naïve interpretation of the information about her visual learning style may actually cause her to talk even less!

ANALYTIC AND HOLISTIC THINKING

One dimension of cognitive style worthy of our attention, however, is a distinction between analytic and holistic thinking. In *analytic* thinking, learners tend to break new stimuli and tasks into their component parts and to see these parts somewhat independently of their context. In *holistic* thinking, learners tend to perceive situations as integrated, indivisible wholes that are closely tied to their context. Researchers have found cultural differences here: People from mainstream Western culture tend to be analytic thinkers, whereas people from East Asian cultures think more holistically (Park & Huang, 2010; Varnum, Grossmann, Kitayama, & Nisbett, 2010). In general, logical and scientific reasoning requires analytic thinking, but holistic thinking can help learners identify associations and relationships among seemingly very different phenomena. For example, holistically minded Chinese scientists identified the underlying cause of the ocean's tides—the moon's gravitational pull on any large body of water—many centuries before more narrowly focused, earth-centered European scientists did (Nisbett, 2009).

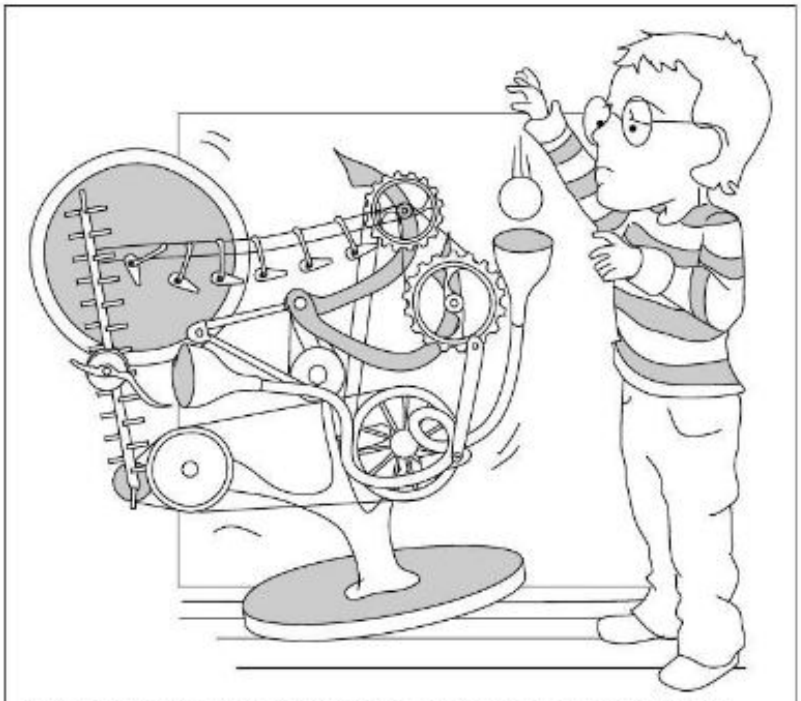
In contrast to the mixed research findings regarding cognitive styles and learning styles, research on dispositions has yielded more consistent and fruitful results. Some kinds of dispositions are clearly beneficial for classroom learning:

- *Stimulation seeking:* Eagerly interacting with one's physical and social environment in order to gain new experiences and information
- *Need for cognition:* Regularly seeking and engaging in challenging cognitive tasks
- *Critical thinking:* Consistently evaluating information or arguments in terms of their accuracy, credibility, and worth, rather than accepting them at face value
- *Open-mindedness:* Flexibly considering alternative perspectives and multiple sources of evidence, and suspending judgment for a time rather than leaping to immediate conclusions (Cacioppo, Petty, Feinstein, & Jarvis, 1996; DeBacker & Crowson, 2008, 2009; Furnham, 2012; Halpern, 2008; Kang et al., 2009; Raine, Reynolds, & Venables, 2002; Southerland & Sinatra, 2003; Stanovich, 1999; West, Toplak, & Stanovich, 2008)

Such dispositions are often positively correlated with students' learning and achievement, and many theorists have suggested that they play a causal role in what and how much students learn. In fact, dispositions sometimes overrule intelligence in their influence on long-term achievement (Dai & Sternberg, 2004; Kuhn & Franklin, 2006; Perkins & Ritchhart, 2004). For instance, children who eagerly seek out physical and social stimulation as preschoolers later become better readers and earn better grades in school (Raine et al., 2002). Students with a high need for

cognition learn more from what they read and are more likely to base conclusions on sound evidence and logical reasoning (Cacioppo et al., 1996; Dai, 2002; P. K. Murphy & Mason, 2006). And students who critically evaluate new evidence and open-mindedly listen to diverse perspectives show more advanced reasoning capabilities and are more likely to revise their beliefs in the face of contradictory information (DeBacker & Crowson, 2009; G. Matthews, Zeidner, & Roberts, 2006; Southerland & Sinatra, 2003).

Researchers haven't yet systematically addressed the origins of various dispositions. Perhaps inherited temperamental differences (e.g., in stimulation seeking) are involved (Raine et al., 2002). Beliefs about the underlying nature of knowledge—for instance, the belief that knowledge is fixed and unchanging, on the one hand, or dynamic and continually evolving, on the other—may also play a role (P. M. King & Kitchener, 2002; Kuhn, 2001b; Mason, 2003). And almost certainly teachers' actions and the general classroom atmosphere they create—for example, whether students are encouraged to pursue intriguing topics, take risks, and think critically—make a difference (Flum & Kaplan, 2006; Gresalfi, 2009; Kuhn, 2001b, 2006). In the following classroom interaction, a teacher actually seems to *discourage* any disposition to think analytically and critically about classroom material:



Children differ in their desires for intellectual stimulation and challenging cognitive tasks.

Beliefs about the underlying nature of knowledge are known as *epistemic beliefs* (see Chapter 7).

> Write this on your paper . . . it's simply memorizing this pattern. We have meters, centimeters, and millimeters. Let's say . . . write millimeters, centimeters, and meters. We want to make sure that our metric measurement is the same. If I gave you this decimal, let's say .234 m (yes, write that). In order to come up with .234 m in centimeters, the only thing that is necessary is that you move the decimal. How do we move the decimal? You move it to the right two places. . . . Simple stuff. (Turner, Meyer, et al., 1998, p. 741)

Undoubtedly this teacher means well, but notice the noncritical attitude she communicates: "Write this . . . it's simply memorizing this pattern." The Into the Classroom feature "Promoting Productive Dispositions" offers strategies that are more likely to be effective.

Educating Students with Special Needs in General Education Classrooms

As teachers, we can typically accommodate many students' varying abilities and dispositions within the context of a single curriculum and everyday classroom lessons. But we're also likely to have students with special needs—students who are different enough from their peers that they require specially adapted instructional materials and practices to help them maximize their learning and achievement. Some of these students have cognitive, personal, social, or physical disabilities that adversely affect their performance in a typical classroom. Others, instead, are so advanced in a particular domain—that is, they are *gifted*—that they gain little from grade-level activities and assignments.

In the United States, most students with special educational needs are in general education classrooms for part or all of the school day—a practice known as inclusion (U.S. Department of Education, National Center for Education Statistics, 2010). In fact, federal legislation mandates that students with disabilities be educated in neighborhood schools and, ideally, in regular classrooms to the greatest extent possible.

PUBLIC LAW 94-142: INDIVIDUALS WITH DISABILITIES EDUCATION ACT (IDEA)

In 1975 the U.S. Congress passed Public Law 94-142, which is now known as the Individuals with Disabilities Education Act (IDEA). This act has been amended and reauthorized several times since then, most recently in 2004 under the name *Individuals with Disabilities Education Improvement Act.* It currently grants educational rights from birth until age 21 for people with cognitive, emotional, or physical disabilities. It guarantees several rights for students with disabilities:

- *A free and appropriate education.* All students with disabilities are entitled to a free educational program designed specifically to meet their unique educational needs.
- *Fair and nondiscriminatory evaluation.* A multidisciplinary team conducts an in-depth evaluation of any student who may be eligible for special services. The team's makeup depends on the student's needs but typically consists of two or more teachers, any appropriate specialists, and the student's parent(s) or guardian(s). Using a variety of tests and other evaluation tools, school personnel conduct a complete assessment of potential disabling conditions. Evaluation procedures must take a student's background and any suspected physical or communication difficulties into account. For example, tests must be administered in a student's primary language.
- *Education in the least restrictive environment.* To the greatest extent possible, students with disabilities should be included in the same academic environment, extracurricular activities, and social interactions as their nondisabled peers. That is, they must have the least restrictive environment, the most typical and standard educational environment that,

with sufficient supplementary aids and support services, can reasonably meet their needs. Exclusion from general education is warranted only when others' safety would be jeopardized or when, even with proper support and assistance, a student can't make appreciable progress in a general education setting.

- *Individualized education program (IEP).* When an individual aged 3 to 21 is identified as having a disability, the multidisciplinary team collaboratively develops an instructional program, called an individualized education program (IEP), tailored to the individual's strengths and weaknesses (see Figure 5.2). The IEP is a written statement that the team continues to review and, if appropriate, revise at least once a year—more frequently if conditions warrant. IEP meetings are most effective when they (a) are well planned and (b) have a designated meeting facilitator, a clear agenda, and ground rules for how to run the meeting, and when participants (c) have sufficient knowledge about these meetings and avoid using jargon (Diliberto & Brewer, 2014).
- *Due process.* IDEA mandates several practices that ensure that students' and parents' rights are preserved throughout the decision-making process. For instance, parents must be notified in writing before the school takes any action that might change their child's educational program. If the parents and school system disagree on the most appropriate placement for a child, mediation or a hearing can be used to resolve the differences.

IDEA has had a significant impact on the nature of special education. More and more, teachers are realizing that truly inclusive practices require differentiated instruction for *all* students, not just those with formally identified needs. And rather than provide specialized instruction in a separate classroom, many special education teachers now partner with regular classroom teachers to jointly teach all students—both those with disabilities and those without.

POTENTIAL BENEFITS AND DRAWBACKS OF INCLUSION

Despite the mandates of IDEA, inclusive practices for students with disabilities have been controversial. Some experts argue that students are most likely to develop normal peer relationships and social skills when they participate fully in their school's overall social life. But others worry that when students with special needs are in a regular classroom for the entire school day, they can't get the intensive specialized instruction they may need. Furthermore, nondisabled classmates may stigmatize, avoid, or bully students who appear to be odd or incompetent in some way (Blake, Lund, Zhou, Kwok, & Benz, 2012; Hamovitch, 2007).

Numerous research studies have suggested that attending general education classes for part or all of the school day can have several positive outcomes for students with disabilities:

- Academic achievement equivalent to (and sometimes higher than) that in a self-contained classroom

FIGURE 5.2 Components of an individualized education program (IEP).

In the United States, any IEP written for a student with a disability must include the following information:

- *Current performance:* Information about the student's current school achievement levels, including classroom tests and assignments, teachers' and specialists' observations, and results of individually administered assessments.
- *Annual goals:* objectives or benchmarks for the school year related to the student's academic, social, behavioral, and/or physical needs.
- *Special education and related services:* The special services, supplementary aids, and program modifications that will be provided in order to help the student meet the annual goals.
- *Participation with nondisabled children:* If applicable, explanation of the extent to which the student will *not* participate in regular classroom and extracurricular activities.
- *Measurement of progress:* Information regarding how the student's progress will be monitored and how parents will be informed of this progress.
- *Participation in state and district-wide tests:* Explanation of any modifications or exclusions with respect to regularly administered achievement tests and, if applicable, description of any alternative measures of achievement.
- *Dates and places:* Information regarding when and where services will begin and how long they will continue.
- *Transition services:* For any student aged 14 (or younger, if appropriate), any special services needed for reaching post-school goals and preparing to leave school.

Source: U.S. Department of Education, Office of Special Education and Rehabilitative Services, 2000.

- More appropriate classroom behavior, better social skills, and more frequent interaction with nondisabled peers
- Better sense of self *if* the school environment is one in which all students accept and respect individual differences among their peers (Halvorsen & Sailor, 1990; Hamovitch, 2007; Hattie, 2009; P. Hunt & Goetz, 1997; MacMaster, Donovan, & MacIntyre, 2002; Slavin, 1987; Soodak & McCarthy, 2006; Stainback & Stainback, 1992)

We're especially likely to see such outcomes when students understand the nature of their disabilities and when instruction and materials are tailored to students' specific needs, perhaps in their regular classrooms or perhaps in short resource-room sessions (e.g., H. L. Swanson, Hoskyn, & Lee, 1999). Appropriate **assistive technology**—electronic devices and other equipment that can enhance students' abilities and performance—is also extremely valuable in helping students successfully participate in the curriculum and social life of general education classrooms.

Nondisabled students often benefit from inclusive practices as well. For example, they may be able to take advantage of special supports designed for students with disabilities—perhaps detailed study guides or supplementary explanations (C. M. Cole et al., 2004). Furthermore, they acquire an increasing awareness of the heterogeneous nature of the human race and discover that individuals with special needs are in many respects very much like themselves (P. Hunt & Goetz, 1997; D. Staub, 1998). One of us authors often thinks about her son Jeff's friendship with Evan, a classmate with severe physical and cognitive disabilities, during their third-grade year. A teacher had asked Jeff to be a special friend to Evan, interacting with him at lunch and whenever possible. Although largely unable to speak, Evan always made it clear through gestures and expressions that he was delighted to spend time with his friend, giving Jeff—who was quite shy—a boost in social self-confidence. Several years later Jeff reflected on this friendship:

> It made me realize that Evan was a person too. It made me realize that I could have a friendship with a boy with disabilities. Doing things that made Evan happy made me happy as well. I knew that *Evan* knew that we were friends.

Students with Specific Cognitive or Academic Difficulties

Some students with special educational needs show no outward signs of physical disability yet have cognitive difficulties that interfere with their ability to learn certain kinds of academic material or perform certain kinds of classroom tasks. Such students include those with learning disabilities, attention-deficit hyperactivity disorder, and speech and communication disorders.

LEARNING DISABILITIES

Although there are varying definitions of learning disabilities, students with learning disabilities have significant difficulties in one or more specific cognitive processes that can't be attributed to cultural or linguistic diversity, generally delayed cognitive development, emotional problems, sensory impairment, or environmental deprivation. Such difficulties often appear to result from specific and possibly inherited brain dysfunctions (American Psychiatric Association, 2013; N. Gregg, 2009; K. Pugh & McCardle, 2009). Figure 5.3 lists several forms that a learning disability might take.

COMMON CHARACTERISTICS

In general, students with learning disabilities are different from one another in many more ways than they are similar. They typically have many strengths but may also face challenges:

- Poor reading and writing skills
- Ineffective learning and memory strategies
- Trouble concentrating on and completing assigned tasks, especially in the face of distractions
- Poor sense of self and low motivation for academic tasks, especially in the absence of individualized assistance in areas of difficulty
- Poor motor skills
- Poor social skills (Estell et al., 2008; Gathercole, Lamont, & Alloway, 2006; N. Gregg, 2009; Job & Klassen, 2012; K. Pugh & McCardle, 2009; Swanson, in press; Waber, 2010)

By no means do such characteristics describe *all* students with learning disabilities. For instance, some are attentive in class, and some are socially skillful and popular with peers.

Sometimes learning disabilities reflect a mismatch between students' developing abilities, on the one hand, and grade-level expectations for performance, on the other (Waber, 2010). For instance, as students reach middle school, they're typically expected to work with little or no supervision, yet students with learning disabilities don't always have the time management skills they need to get things done (N. Gregg, 2009). In high school classes, learning may require

reading and studying sophisticated textbooks, yet the average high school student with a learning disability reads at a fourth- to fifth-grade level and has few, if any, effective study strategies (Cutting, Eason, Young, & Alberstadt, 2009; Meltzer & Krishnan, 2007).

The following exercise can give you a sense of how these students might feel under such circumstances.

EXPERIENCING FIRSTHAND A READING ASSIGNMENT

Read the following passage carefully. You'll be tested on its contents later in the chapter.

> Personality research needs to refocus on global traits because such traits are an important part of everyday social discourse, because they embody a good deal of folk wisdom and common sense, because understanding and evaluating trait judgments can provide an important route toward the improvement of social judgment, and because global traits offer legitimate, if necessarily incomplete, explanations of behavior. A substantial body of evidence supporting the existence of global traits includes personality correlates of behavior, interjudge agreement in personality ratings, and the longitudinal stability of personality over time. Future research should clarify the origins of global traits, the dynamic mechanisms through which they influence behavior, and the behavioral cues through which they can most accurately be judged. (Funder, 1991, p. 31)

How well do you think you will perform on the upcoming test about this passage?

The passage you just read is a fairly typical one from *Psychological Science,* a professional journal written for people with advanced education (e.g., doctoral degrees) in psychology. Hence, it was written well above a typical college student's reading level. We won't *really* test you on the passage's contents, but we authors hope that the exercise gave you a feel for the frustration that high school students with learning disabilities might experience. For many students with learning disabilities, completing school assignments may constantly seem like fighting an uphill battle. Perhaps for this reason, a higher-than-average percentage of students with learning disabilities drop out of school before graduation (N. Gregg, 2009).

ADAPTING INSTRUCTION

Instructional strategies for students with learning disabilities must be tailored to students' specific strengths and weaknesses. If you become a regular classroom teacher, you will quite likely partner with a special educator when you have students with learning disabilities in your classes. You and the special educator will work collaboratively to adapt your instruction at times. Several strategies should benefit many of these students:

FIGURE 5.3 Examples of cognitive processing deficiencies in students with learning disabilities.

Perceptual difficulty. Students may have trouble understanding or remembering information they receive through a particular modality, such as vision or hearing.

Memory difficulty. Students may have less capacity for remembering information over either the short or long run (i.e., they may have problems with either *working memory* or *long-term memory*).

Metacognitive difficulty. Students may have difficulty using effective learning strategies, monitoring progress toward learning goals, and in other ways directing their own learning.

Oral language processing difficulty. Students may have trouble understanding spoken language or remembering what they have been told.

Reading difficulty. Students may have trouble recognizing printed words or comprehending what they read; extreme form is known as *dyslexia*.

Written language difficulty. Students may have problems in handwriting, spelling, or expressing themselves coherently on paper; an extreme form is known as *dysgraphia*.

Mathematical difficulty. Students may have trouble thinking about or remembering information involving numbers; an extreme form is known as *dyscalculia*.

Social perception difficulty. Students may have trouble interpreting others' social cues and signals and thus may respond inappropriately in social situations.

Music processing difficulty. Students may have little sensitivity to differences in pitch and be unable to recognize familiar tunes; an extreme form is known as *amusia*.

ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

Virtually all students are apt to be inattentive, hyperactive, and impulsive at one time or another. But those with **attention-deficit hyperactivity disorder (ADHD)** typically have significant and chronic deficits in these areas, as reflected in the following identification criteria:

- *Inattention*. Students may have considerable difficulty focusing and maintaining attention on assigned tasks, especially when appealing alternatives are close at hand. They may have trouble listening to and following directions, and they may often make careless mistakes.
- *Hyperactivity*. Students may seem to have an excess amount of energy. They're apt to be fidgety and may move around the classroom at inappropriate times.
- *Impulsivity*. Students almost invariably have trouble inhibiting inappropriate behaviors. They may blurt out answers, begin assignments prematurely, or engage in risky or destructive behaviors without thinking about potential consequences. (American Psychiatric Association, 2000; Barkley, 2006; Gatzke-Kopp & Beauchaine, 2007; N. Gregg, 2009)

Students with ADHD don't necessarily show all three of these characteristics. For instance, some are inattentive without also being hyperactive, as is true for Tim in the opening case study. But all students with ADHD appear to have one characteristic in common: an *inability to inhibit inappropriate thoughts, inappropriate actions, or both* (Barkley, 2006, 2010; B. J. Casey, 2001; Nigg, 2010). Tim, for example, is easily distracted by his thoughts and daydreams when he should be focusing on a classroom lesson.

The prevalence of ADHD in the United States may surprise you. First, boys are about twice as likely as are girls to be diagnosed with ADHD. In the United States approximately 6.4 million students are diagnosed with ADHD at some point in time. In addition, these diagnoses have increased by 53% over the past decade (National Center for Learning Disabilities, 2014). The increase in diagnoses is due to a number of factors, including greater awareness of ADHD and thus more frequent diagnoses.

In many instances, ADHD appears to be the result of brain abnormalities that limit students' ability to focus their attention and control their behaviors (e.g., Kadziela-Olech, Cichocki, Chwiesko, Konstantynowicz, & Braszko, 2015). Sometimes these abnormalities are inherited, but sometimes, instead, they're the result of toxic substances in children's early environments—perhaps high lead content in the paint dust of old buildings (Accardo, 2008; Barkley, 2010; Faranoe et al., 2005; Gatzke-Kopp & Beauchaine, 2007; Nigg, 2010).

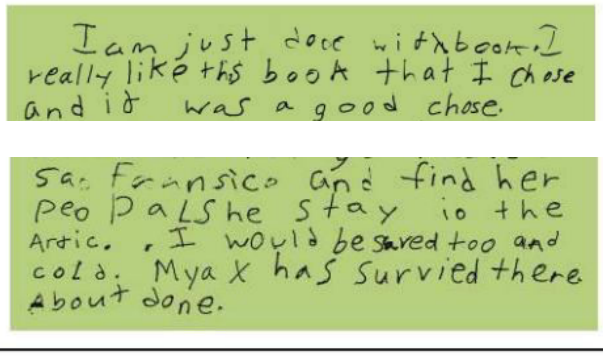
COMMON CHARACTERISTICS

In addition to inattentiveness, hyperactivity, and impulsivity, students identified as having ADHD may have characteristics such as these:

- Exceptional imagination and creativity; exceptionally detailed memories
- Certain specific cognitive processing difficulties (e.g., see Figure 5.6) and low school achievement
- Problems with planning and time management
- Classroom behavior problems (e.g., disruptiveness, noncompliance)
- Poor social skills and interpersonal difficulties
- Increased probability of substance abuse in adolescence (Barkley, 2006; Gatzke-Kopp & Beauchaine, 2007; S. Goldstein & Rider, 2006; N. Gregg, 2009; Hallowell, 1996; Skowronek, Leichtman, & Pillemer, 2008; Tarver, Daley, & Sayal, 2014)

Students' attention, hyperactivity, and impulsiveness problems may diminish somewhat in adolescence, but they don't entirely disappear, making it difficult for students to handle the increasing demands that come in high school; for many, ADHD continues into and sometimes throughout adulthood (Tarver, Daley, & Sayal, 2014). Accordingly, students with ADHD are at greater-than-average risk for dropping out of school (Barkley, 2006; S. Goldstein & Rider, 2006; N. Gregg, 2009; E. L. Hart, Lahey, Loeber, Applegate, & Frick, 1995). ADHD continues to be a life-long issue for some individuals (Tarver et al., 2014).

FIGURE 5.6 **Like many students with ADHD, 10-year-old Joshua has specific cognitive processing difficulties. Although he has the math skills of a typical fifth grader, he has delayed reading comprehension and writing skills, as reflected in the book report shown here. Josh can more easily express his thoughts orally.**


I am just done with book. I really like this book that I chose and it was a good chose.

Sa: Fransico and find her peo PALS he stay io the Artic. , I would be saved too and cold. Mya X has survied there About done.

ADAPTING INSTRUCTION

Some students with ADHD take medication that helps them control their symptoms. But medication alone is rarely sufficient to enable classroom success; individually tailored educational interventions are also in order (Purdie, Hattie, & Carroll, 2002). The strategies previously listed for students with learning disabilities can often be helpful

SPEECH AND COMMUNICATION DISORDERS

Speech and communication disorders are impairments in spoken language or language comprehension that significantly interfere with students' academic performance. Examples include persistent articulation problems (e.g., see Figure 5.7), stuttering, abnormal syntactical patterns, and difficulty understanding other people's speech. By the time children reach the first grade, about 5% have noticeable speech disorders (National Institute of Deafness and Other Communication Disorders, 2010). Sometimes, but not always, these children have difficulty perceiving and mentally processing particular aspects of spoken language—a subcategory of speech and communication disorders known as *specific language impairments*. And often—but again, not always—the source of the disorder can be traced to heredity or brain abnormalities (Bishop, 2006; J. L. Locke, 1993; Spinath, Price, Dale, & Plomin, 2004).

COMMON CHARACTERISTICS

Although some students with speech and communication disorders have other disabilities as well, many of them are in most ways just typical students. Nevertheless, the following characteristics are fairly common:

- Reluctance to speak; embarrassment and self-consciousness when speaking
- Difficulties in reading and writing (Fey, Catts, & Larrivee, 1995; Heward, 2009; LaBlance, Steckol, & Smith, 1994; Rice, Hadley, & Alexander, 1993)

ADAPTING INSTRUCTION

Usually a trained specialist will work with students to help them improve or overcome their speech and communication difficulties. Although students may display deficits in only one noticeable part of speech, the specialist quite likely will intervene and work on a variety of aspects of speech (Owens, Farinella, & Metz, 2015). Nevertheless, general education teachers can assist in several ways:

Students with Social or Behavioral Problems

Many students have minor social, emotional, or behavioral difficulties at one time or another, particularly during times of unusual stress or major life changes. Often these problems are temporary ones that require only a little extra support from caring adults and peers. At other times problems are more enduring but *don't* reflect a disability. Perhaps a student's temperament is a poor fit with a teacher's instructional strategies—for instance, an especially fidgety child may perform poorly on lengthy seatwork assignments—or perhaps a teacher simply hasn't made clear the expectations and rules for classroom behavior (Keogh, 2003; Mehan, 1979). In such situations students' problems may decrease or disappear with a change in instructional practices or classroom management strategies.

However, some students show a pattern of engaging in behaviors that consistently interfere with their learning and performance *regardless* of the teacher and the classroom environment. In this section we'll look at two groups of students who fit into this category: those with emotional and behavioral disorders and those with autism spectrum disorders.

EMOTIONAL AND BEHAVIORAL DISORDERS

Students with **emotional and behavioral disorders** become identified as students with special needs—and therefore qualify for special educational services—when their problems have a

substantial negative impact on classroom learning. Nevertheless, in the United States, some students do not receive adequate services; although these students represent between 3% and 6% of the population of students, less than 1% receive special education services under this categorization (Lane, Menzies, Kalberg, & Oakes, 2012). Symptoms of emotional and behavioral disorders typically fall into one of two broad categories. Externalizing behaviors have direct or indirect effects on other people; examples include aggression, defiance, stealing, and general lack of self-control. Internalizing behaviors primarily affect the student with the disorder; examples include severe anxiety or depression, exaggerated mood swings, withdrawal from social interaction, and eating disorders. Students with externalizing behaviors—who are more likely to be boys than girls—are more likely to be referred for evaluation and possible special services. However, students with internalizing behaviors—who are more likely to be girls than boys—can be just as much at risk for school failure (Angold, Worthman, & Costello, 2003; Gay, 2006; Hayward, 2003). These disorders need to be taken seriously, because, in addition to school failure, students with externalizing and internalizing behaviors are more at risk for serious mental health issues, including thinking about or attempting suicide (Peter & Roberts, 2010).

Some emotional and behavioral disorders result from environmental factors, such as stressful living conditions, child maltreatment, or family alcohol or drug abuse (P. T. Davies & Woitach, 2008; D. Glaser, 2000; Maughan & Cicchetti, 2002). But biological causes (e.g., inherited predispositions, chemical imbalances, brain injuries) may also be involved, either by themselves or through interaction with environmental conditions (Dodge, 2009; Raine, 2008; Yeo, Gangestad, & Thoma, 2007). Some students with a genetic predisposition for an emotional or behavioral disorder exhibit few, if any, signs until adolescence, as the following case illustrates:

> As a ninth grader, Kirk was a well-behaved, likeable student who earned As and Bs and showed particular promise in science and math. But in 10th grade, his grades began to decline, and he increasingly exhibited hostile and defiant behaviors. When Kirk failed three classes during the fall of his 12th-grade year, the school principal convened a meeting with him, his parents, and his faculty advisor to discuss how to help Kirk get back on track. At the meeting the principal described several occasions on which Kirk had acted disoriented, belligerent, and seemingly "high" on drugs. Despite his strong desire to attend college the following year, Kirk sat at the meeting smirking (seemingly gleeful about his predicament) and focusing his attention on sorting pieces of trail mix in a bowl on the conference room table. By the end of the meeting, the principal was so infuriated that she expelled him from school.
>
> Over the next few weeks, Kirk's mental condition and behavior continued to deteriorate, to the point that he was soon arrested, placed in a juvenile detention facility, and eventually hospitalized in the state mental institution.

Kirk was ultimately diagnosed with *bipolar disorder,* a condition that is usually inherited and is characterized by excessive mood swings (hence, the disorder is sometimes called manic depression) and in some cases (like Kirk's) by distorted thought processes. Bipolar disorder often doesn't appear until adolescence, even though its biological underpinnings have been present since birth (Griswold & Pessar, 2000).

When students have emotional or behavioral disorders, their inappropriate behaviors interfere not only with academic achievement but also with peer relationships, leading to social as well as academic failure. Some of these students may seek the companionship of the few peers who will accept them—peers who typically behave in similarly inappropriate ways and may introduce one another to drugs, alcohol, or criminal activity (J. Snyder et al., 2008; Webber & Plotts, 2008). Sadly, many youth who have emotional or behavioral disorders do not receive the services and supports that they need. Often boys with externalizing behaviors receive support, but others sometimes do not receive sufficient services (Hallahan, Kauffman, & Pullen, 2015).

COMMON CHARACTERISTICS

Students with emotional and behavioral disorders differ considerably in their abilities and personalities. However, in addition to the difficulty in maintaining healthy peer relationships just mentioned, you may observe one or more of the following characteristics:

- Frequent absences from school
- Deteriorating academic performance with increasing age
- Often, but not always, below-average intelligence
- Low self-esteem
- Aggressive or withdrawn behaviors
- Little or no empathy for others' distress
- Significant substance abuse (Grinberg & McLean-Heywood, 1999; Harter, 1999; Kauffman & Landrum, 2013; Leiter & Johnsen, 1997; McGlynn, 1998; Richards, Symons, Greene, & Szuszkiewicz, 1995; Turnbull, Turnbull, & Wehmeyer, 2010; Webber & Plotts, 2008)

Some students with emotional and behavioral disorders have other special needs as well, including learning disabilities, ADHD, or giftedness (Fessler, Rosenberg, & Rosenberg, 1991; Gatzke-Kopp & Beauchaine, 2007; Webber & Plotts, 2008).

ADAPTING INSTRUCTION

There is promising research indicating that some specific drug treatments are quite helpful to some children and adolescents with emotional and behavioral disorders (Konopasek & Forness, 2014); however, environmental supports are also important. Effective interventions must be tailored to each student's unique needs, but several strategies can benefit many of these students:

AUTISM SPECTRUM DISORDERS

The central, defining features of autism spectrum disorders are marked impairments in social cognition (e.g., perspective taking, interpreting other people's body language), social skills, language usage, and social interaction. Many students with these disorders prefer to be alone and form weak, if any, emotional attachments to other people. Some students develop limited abilities to use language, whereas others' language usage is more fully developed. Common, too, are repetitive behaviors (often very odd ones rarely seen in age-mates) and inflexible adherence to certain routines or rituals (American Psychiatric Association, 2000; Lord, 2010; Pelphrey & Carter, 2007; Tager-Flusberg, 2007). Autism spectrum disorders are prevalent; in the United States, an estimated 1 out of every 68 children has been identified as having autism spectrum disorder, with five times as many diagnoses in boys as in girls (Centers for Disease Control, 2014).

Aside from similarities in social impairments and repetitive behaviors, individuals with autism spectrum disorders differ considerably in the severity of their condition—hence the term *spectrum*. In Asperger syndrome, a fairly mild form, students usually have normal language skills and average or above-average intelligence. In severe cases, which are often referred to simply as *autism,* children have major delays in cognitive development and language and may exhibit certain bizarre behaviors—perhaps constantly rocking or waving fingers, continually repeating what someone else has said, or showing unusual fascination with a very narrow category of objects (American Psychiatric Association, 2000; Lord, 2010).

The vast majority of autism spectrum disorders are probably caused by abnormalities in the brain. Some researchers have observed abnormalities in *mirror neurons*—neurons that probably underlie people's perspective-taking abilities (Gallese, Gernsbacher, Heyes, Hickok, & Iacoboni, 2011). Other researchers have discovered abnormalities in interconnections among various parts of the brain—for example, in connections between parts that enable logical reasoning or inhibition of impulses, on the one hand, and parts that underlie emotions and emotional processing, on the other (Cherkassky, Kana, Keller, & Just, 2006; I. L. Cohen, 2007; Kana, Keller, Minshew, & Just, 2007). Recent studies suggest that multiple regions of the brain are involved in autism spectrum disorders (Byrnes, 2012). Although some have speculated that autism may be cause by childhood vaccines, there is *no* evidence that there is any association of vaccines with autism (Institute of Medicine, 2011; Maglione et al., 2014). Also, students with autism spectrum disorders may be either undersensitive or oversensitive to environmental stimulation (Ratey, 2001; R. C. Sullivan, 1994; D. Williams, 1996). Temple Grandin, a woman who has gained international prominence as a designer of livestock facilities, recalls what it was like to be a child with autism:

> From as far back as I can remember, I always hated to be hugged. I wanted to experience the good feeling of being hugged, but it was just too overwhelming. It was like a great, all-engulfing tidal wave of stimulation, and I reacted like a wild animal. . . . When I was little, loud noises were also a problem, often feeling like a dentist's drill hitting a nerve. They actually caused pain. I was scared to death of balloons popping, because the sound was like an explosion in my ear. (Grandin, 1995, pp. 63, 67)

COMMON CHARACTERISTICS

In addition to the traits already described, students with autism spectrum disorders may have characteristics such as these:

- Strong visual–spatial thinking skills and exceptional awareness of visual details
- Unusual ability to maintain attention and focus during distractions
- Good memory for a set of unrelated facts
- Difficulty planning and organizing a future course of action
- Strong need for a consistent, predictable environment (I. L. Cohen, 2007; M. Dawson, Soulières, Gernsbacher, & Mottron, 2007; Gernsbacher, Stevenson, Khandakar, & Goldsmith, 2008; Grandin & Johnson, 2005; Lord, 2010; Meltzer, 2007; Pelphrey & Carter, 2007; Tager-Flusberg, 2007)

Occasionally students with autism exhibit *savant syndrome,* possessing an extraordinary ability (e.g., exceptional mathematical, artistic, or musical talent) that is quite remarkable in contrast to other aspects of their mental functioning (I. L. Cohen, 2007; L. K. Miller, 2005; Treffert & Wallace, 2002).

ADAPTING INSTRUCTION

Children with Asperger syndrome are typically in general education classes. Students with autism spectrum disorders also can sometimes participate in general education classes for all or part of the day, although inclusion of these students can be complex, so the support of a special educator often may be necessary (Crosland & Dunlap, 2012). As with other exceptionalities, it is important to include parents in discussions about the most appropriate setting for their children. The mother of a first grader with autism, who advocated for her son to be in a classroom that also had non-special-education students, noted that "If he was in a program that was just with other autistic children, there would be no way for him to pick up the behaviors of typically developing children" (Crane, 2010).

Students with General Delays in Cognitive and Social Functioning

When we use the term *student with general delays in cognitive and social functioning,* we're talking about any student who shows a consistent pattern of developmental delays, regardless of whether the student has been identified as having a disability. Educators sometimes use the term *slow learner* to describe a student who obtains intelligence test scores in the 70s and has noticeable difficulties in most or all parts of the curriculum. A student with especially pronounced difficulties may be identified as having an intellectual disability.

INTELLECTUAL DISABILITIES

You're undoubtedly familiar with the term *mental retardation*. In recent years, however, many special educators have instead advocated for the term intellectual disability in reference to students who show pronounced delays in most aspects of cognitive and social development. More specifically, students with intellectual disabilities exhibit *both* of the following characteristics (Luckasson et al., 2002):

- *Significantly below-average general intelligence*. These students have intelligence test scores that are quite low—usually no higher than 70, reflecting performance in the bottom 2% of their age-group. In addition, these students learn slowly and show consistently poor achievement in virtually all academic subject areas.
- *Deficits in adaptive behavior*. These students behave in ways that we would expect of much younger children. Their deficits in adaptive behavior include limitations in *practical intelligence*—that is, managing the ordinary activities of daily living—and *social intelligence*—that is, conducting themselves appropriately in social situations.

The preceding characteristics must be evident in childhood. Thus, a person who shows them beginning at age 18, perhaps as the result of a serious head injury, would *not* be classified as having an intellectual disability.

Intellectual disabilities are often caused by genetic conditions. For example, most children with Down syndrome have delayed cognitive and social development. Other cases are due to biological but noninherited causes, such as severe malnutrition or excessive alcohol consumption during the mother's pregnancy or oxygen deprivation during birth. In other situations, environmental factors, such as parental neglect or an extremely impoverished and unstimulating home environment may be at fault (Beirne-Smith, Patton, & Kim, 2006).

COMMON CHARACTERISTICS

Like students in any category of special needs, students with intellectual disabilities have differing personalities, strengths, and needs. Nevertheless, many of them are apt to exhibit characteristics such as the following:

- Sociability and a genuine desire to belong and fit in at school
- Less general knowledge about the world
- Poor reading and language skills
- Short attention span
- Poor memory; few or no effective learning and memory strategies
- Difficulty drawing inferences and understanding abstract ideas
- Difficulty generalizing something learned in one situation to a new situation
- Immature play behaviors and interpersonal skills
- Delayed motor skills; conditions that adversely affect performance in physical activities (e.g., heart defects, poor muscle tone) (Beirne-Smith et al., 2006; Bergeron & Floyd, 2006; Carlin et al., 2003; Heward, 2009; F. P. Hughes, 1998; Tager-Flusberg & Skwerer, 2007)

Students with Physical or Sensory Challenges

Some students with special needs have obvious physical disabilities caused by medically detectable physiological conditions. These include physical and health impairments, visual impairments, and hearing loss. A small subset of them have severe and multiple disabilities that require significant adaptations and highly specialized services; such students are typically accompanied by child-specific teacher aides or other specialists when attending general education classrooms.

PHYSICAL AND HEALTH IMPAIRMENTS

Physical and health impairments are general physical or medical conditions (usually long term) that interfere with school performance to such a degree that special instruction, curricular materials, equipment, or facilities are necessary. Students in this category may have limited energy and strength, reduced mental alertness, or little muscle control. Examples of conditions that might qualify students for special services are traumatic brain injury, spinal cord injury, cerebral palsy, epilepsy, cancer, and acquired immune deficiency syndrome (AIDS).

COMMON CHARACTERISTICS

It's hard to generalize about students with physical and health impairments because their conditions are so very different from one another. Nevertheless, several common characteristics are noteworthy:

- Low stamina and a tendency to tire easily
- Varying degrees of intellectual functioning (many of these students have learning ability similar to that of nondisabled peers)
- Lower levels of academic achievement as a result of frequent school absences
- Fewer opportunities to experience and interact with the outside world in educationally important ways (e.g., less use of public transportation, fewer visits to museums and zoos)
- Possible low self-esteem, insecurity, social isolation from peers, or heavy dependence on adults, depending partly on how parents and others have responded to their impairments (Heward, 2009; Patton et al., 1996; J. W. Wood, 1998; Yeo & Sawyer, 2005)

VISUAL IMPAIRMENTS

Students with visual impairments have malfunctions of their eyes or optic nerves that prevent normal vision even with corrective lenses. Some students are totally blind, others see only fuzzy patterns of light and dark, and still others have a restricted visual field (*tunnel vision*) that allows them to see just a very small area at a time. Visual impairments are caused by congenital abnormalities in or damage to either the eye or the visual pathway to the brain. Vision is essential to the development of many cognitive abilities, including reading from print, understanding spatial relationships, and comprehension of concepts (Smith, Polloway, Doughty, Patton, & Dowdy, 2016). When students have visual impairments, these abilities may be delayed, and that could affect learning in all academic subjects.

COMMON CHARACTERISTICS

Students with visual impairments are apt to have many or all of these characteristics:

- Normal functioning of other senses (hearing, touch, etc.)
- General learning ability similar to that of nondisabled students, although visual memory and concept development may be delayed or impaired
- More limited vocabulary, expressive and receptive language, and general world knowledge, in part because of fewer opportunities to experience the outside world in educationally important ways (e.g., less exposure to maps, films, and other visual material)
- Delayed motor development; reduced capability to imitate others' behaviors
- Inability to observe other people's body language and other nonverbal cues, leading to occasional misunderstanding of others' messages and immature social behaviors
- Uncertainty and anxiety (especially in chaotic environments, such as the lunchroom or playground) as a result of having no visual knowledge of ongoing events
- In the primary grades, less knowledge about the conventions of written language (direction of print, punctuation, etc.) (M. Harris, 1992; Heward, 2009; Hobson, 2004; Patton et al., 1996; Smith et al., 2016; Tompkins & McGee, 1986; Turnbull et al., 2010; Tuttle & Tuttle, 1996)

HEARING LOSS

Students with hearing loss have a malfunction of the ears or associated nerves that interferes with the perception of sounds within the frequency range of normal human speech. Two to three of every 1,000 children born in the United States have detectable hearing loss at birth (National Institute on Deafness and Other Communication Disorders, 2014). Students who are completely *deaf* have insufficient sensation to understand any spoken language, even with the help of a hearing aid. Students who are *hard of hearing* understand some speech but experience exceptional difficulty in doing so.

COMMON CHARACTERISTICS

Most students with hearing loss have normal intellectual abilities (Braden, 1992; Schirmer, 1994). However, they may have characteristics such as these:

- Delayed language development because of reduced exposure to spoken language, especially if the impairment was present at birth or emerged early in life
- Proficiency in sign language, such as American Sign Language (ASL) or finger spelling
- Some ability to read lips (*speechreading*)
- Less oral language than that of hearing classmates; perhaps a monotonous, hollow quality to speech
- Less developed reading skills, especially if language development has been delayed
- Less general world knowledge because of reduced exposure to spoken language
- Some social isolation, more limited social skills, and reduced perspective-taking ability as a result of a reduced ability to communicate (Bassett et al, 1996; Chall, 1996; P. L. Harris, 2006; Heward, 2009; C. C. Peterson, 2002; M. B. Rowe, 1978; Schick, de Villiers, de Villiers, & Hoffmeister, 2007; Turnbull et al., 2010)

Students with Advanced Cognitive Development

Many students are apt to have advanced abilities, either in specific subject areas or across the curriculum, that warrant attention and encouragement. Some students—those who are *gifted*—are so far above the norm that special educational services are often appropriate. We often will encounter gifted students in our classes; as we'll see, there are numerous considerations in adapting instruction to engage and challenge gifted students.

GIFTEDNESS

In general, giftedness is unusually high ability or aptitude in one or more areas (e.g., in math, science, creative writing, or music) to such a degree that special educational services are necessary to help the student meet his or her full potential. In most instances giftedness is probably the result of both a genetic predisposition and environmental nurturing (Dai, 2010; Simonton, 2001; Winner, 2000b). In some cases, however, special gifts and talents are largely the result of intensive practice and mentoring (Ericsson, 2003; Gladwell, 2006). The identification of a child as gifted is often a reflection of the values of one's society. Thus, a student who is gifted in sculpting might not be identified as such in a community in which sculpting (or art, more generally) is not valued (Subotnik, Olszewski-Kubilius, & Worrell, 2011).

Giftedness is not included in IDEA. In the United States, the Jacob K. Javits Gifted and Talented Student Education Act of 1987 (reauthorized in 1994 and 2001) encourages but doesn't necessarily mandate special educational services for students who are gifted. Many state governments also either encourage or mandate such services. School districts often use multiple criteria—sometimes including intelligence test scores, sometimes not—to identify students who show exceptional promise in general academic ability, specific academic fields, creativity, or the arts. A current debate is whether gifted education should be to develop eminence and talent, or to provide opportunities for students to develop newly emerging talents (Subotnik & Rickoff, 2010).

COMMON CHARACTERISTICS

Students who are gifted vary considerably in their unique strengths and talents, and those who show exceptional talent in one area may have only average ability in another (Winner, 2000b). Nevertheless, many students who are gifted have characteristics such as these:

- Advanced vocabulary, language, and reading skills
- Extensive general knowledge about the world
- Ability to learn more quickly, easily, and independently than peers
- Advanced and efficient cognitive processes and learning strategies
- Considerable flexibility in ideas and approaches to tasks
- High standards for performance (sometimes to the point of unhealthy perfectionism)
- High motivation to accomplish challenging tasks; boredom during easy tasks
- Strong interest in the area in which strengths have been identified
- Positive self-concept, especially with regard to academic endeavors
- Average or above-average social development and emotional adjustment (although a few extremely gifted students may have difficulties because they are so *very* different from their peers) (Dai, 2010; Mendaglio, 2010; Parker, 1997; Shavinina & Ferrari, 2004; Steiner & Carr, 2003; Subotnik et al., 2011; Subotnik, Olszewski-Kubilus, & Worrell. 2012; Winner, 2000a, 2000b)

To some degree, the nature of giftedness depends somewhat on where students are in their developmental journeys (Dai, 2010; D. J. Matthews, 2009). In the preschool and early elementary years, giftedness might take the form of precociousness in certain general domains; for example, a first grader might be reading sixth-grade-level books or exhibit exceptional facility with numbers. By the upper elementary and secondary grades, some students are likely to show exceptional achievement in very specific areas—perhaps in creative writing, computer technology, or music.

Considering Diversity When Identifying and Addressing Special Needs

Sadly, a disproportionately large number of minority-group students are identified as having disabilities, especially specific cognitive disabilities, general intellectual disabilities, and emotional and behavioral disorders (McLoyd, 1998; U.S. Department of Education, 2006; VanTassel-Baska, 2008). Most theorists attribute the differing identification rates to environmental conditions that often accompany low socioeconomic status: higher-than-normal exposure to environmental toxins, poor nutrition, inadequate medical care, limited access to enriching educational resources, and so on (e.g., Dyson, 2008; Jacoby & Glauberman, 1995; McLoyd, 1998). Also, English language learners are identified as having learning disabilities or intellectual disabilities more often than native English speakers—a finding that probably reflects students' difficulty in understanding and responding to items on language-based diagnostic tests (A. L. Sullivan, 2008).

The higher-than-average identification rates for minority-group students pose a dilemma for educators. On the one hand, we don't want to assign a label such as *intellectual disability* or *emotional disorder* to students whose classroom performance and behavior may be due largely to their challenging living conditions. On the other hand, we don't want to deprive these students of special educational services that might help them learn and achieve more successfully over the long run. In such situations we must conduct fair and nondiscriminatory evaluations of students' needs, and if students qualify under a special-needs category, we must create IEPs to meet those needs. We should consider these categories of special needs as *temporary* classifications that may no longer be applicable as students' classroom performance improves. *All* students, with and without disability classifications, have changing needs that evolve over time, and federal law requires that IEPs be revisited at least once a year.

In addition to being overrepresented in programs for students with disabilities, members of some minority groups are underrepresented in programs for gifted students (D. Y. Ford, 2012, 2014; Graham, 2009; VanTassel-Baska, 2008). Furthermore, when students from underrepresented groups are identified for participation in gifted education programs, teachers often need to carefully mentor and monitor students to encourage them to remain in these programs (Moore, Ford, & Milner, 2011). On average, students from cultural and ethnic minority groups are at a disadvantage when traditional tests of ability are used to identify giftedness—in some cases because they've had little experience with the kinds of tasks that appear on those tests (Rogoff, 2003). It's critical, then, that we be on the lookout for other signs of giftedness, including the following:

- Exceptional talent in a specific area (e.g., in music or video game design)
- Ability to learn quickly from experiences
- Exceptional communication skills (e.g., articulateness, richness of language)
- Originality and resourcefulness in thinking and problem solving
- Ability to generalize concepts and ideas to new, seemingly unrelated situations (Dai, 2010; Haywood & Lidz, 2007; Winner, 1996)

For the growth of our society over the long run, it's imperative that we nurture the many gifted students in *all* cultural and ethnic groups.

Islamic Online University
Lecture Notes for Modules 11 & 12

TEXTBOOK CHAPTER 6: LEARNING, COGNITION, AND MEMORY

LEARNING OUTCOMES

1 Distinguish among four distinct approaches to the study of human learning, and summarize one of these approaches - cognitive psychology - in terms of five basic assumptions.
2 Describe and illustrate the key components that many researchers believe may characterize the human memory system.
3 Apply your knowledge of long-term memory storage in identifying effective strategies for enhancing students' learning.
4 Explain how students' self-constructed beliefs can sometimes interfere with effective learning, and identify several ways of helping students productively revise such beliefs.
5 Describe several factors that influence students' ability to recall what they have previously learned; also describe five possible reasons why students may either forget or incorrectly remember what they have learned.
6 Give examples of the diversity in cognitive processes you are likely to see in students, in some cases as a result of students' cultural background or special educational needs.

CASE STUDY: BONES

In biology class Kanesha has been struggling to learn the names of the bones in the human body, from head (cranium) to toe (metatarsus). She has learned a few bones quickly and easily. For example, she realizes that, logically, the *nasal bone* should form part of the nose, and she remembers the *humerus* (upper arm bone) by thinking of it as being just above one's funny ("humorous") bone. But she's still confused about some of the other bones. For example, the *tibia* and *fibula* have similar-sounding names and are both located in the lower leg. And she keeps thinking that the *sternum* (at the front of the chest) is actually in the back of the body, just as the stern of a boat is at its rear. She also has trouble remembering bones whose names don't provide any clues about their location. The coccyx, ulna, sacrum, clavicle, and patella could be just about anywhere in the body, it seems.

To prepare for an upcoming quiz, Kanesha looks at a diagram of the human skeleton and whispers the name of each bone to herself several times. She also writes each name on a sheet of paper. "These terms will certainly sink in if I repeat them enough times," she tells herself. But Kanesha scores only 70% on the quiz. As she looks over her incorrect answers, she sees that she confused the tibia and the fibula, labeled the ulna as "clavicle," put the sternum in the wrong place, and completely forgot about the coccyx, sacrum, and patella.

Case Study Analysis

Tim Bones

Why are some bones easier for Kanesha to remember than others?

Kanesha uses what she knows already to help her remember the names. This strategy is useful for remembering the humerus but leads her astray when she tries to learn the sternum, and she has particular difficulty if she has no association and no other information that would help her understand why the bone has a particular name. Kanesha's strategy of simply repeating the names verbally and in writing does not provide any meaningful context for those names. For example, the coccyx bone is named for its shape like a bird's beak — the name comes from the Greek word *kókkyx,* which translates as cuckoo. This information would likely help Kanesha remember the name.

Which ones would be easiest for you to remember?

The answer will depend on students' own background knowledge.

Basic Assumptions of Cognitive Psychology

At the core of cognitive psychology are several basic assumptions about how people learn.

- *Cognitive processes influence what is learned.* The specific things people mentally do as they try to interpret and remember what they see, hear, and study—that is, their cognitive processes—have a profound effect on what they specifically learn and remember. For example, in the opening case study, Kanesha thinks about the nasal bone and humerus in ways that should help her remember them. However, she thinks about the sternum in a way that *interferes* with her ability to remember it correctly, and she gives little or no thought to why certain other bones have particular names. The extent to which Kanesha thinks about the material she needs to learn—and also *how* she thinks about it—affects her performance on the quiz.

- *People's cognitive processes can sometimes be inferred from their behaviors.* Historically, some psychologists—especially behaviorists—have argued that we can't directly observe people's thinking and therefore can't study it objectively and scientifically. Cognitive psychologists disagree, suggesting that by observing people's responses to various objects and events, it's possible to draw reasonable *inferences*—to make educated guesses—about the cognitive processes that probably underlie the responses. As an example of how we might learn about people's cognitive processes by observing their behaviors, try the following exercise.

EXPERIENCING FIRSTHAND

REMEMBERING 12 WORDS

Read the 12 words below *one time only*. Then cover up the page, and write down the words in the order they come to mind.

shirt	table	hat
carrot	bed	squash
pants	potatoes	stool
chair	shoe	bean

Did you write down the words in the order in which you had read them? Probably not. If you're like most people, you recalled the words by category—perhaps clothing first, then vegetables, then furniture. From the order in which you wrote the words (i.e., from your *behavior*), we can draw an inference about an internal cognitive process that occurred as you learned the words: You mentally *organized* them into categories.

- *People are selective about what they mentally process and learn.* We human beings are constantly bombarded with information. Consider the many stimuli you're encountering at this very moment—for instance, the many letters on this page, the many others objects you can see while you're reading, the many sounds reaching your ears, and the various articles of clothing touching your skin. You've probably been ignoring most of these stimuli until just now, when you were specifically asked to think about them.

  It's useful to distinguish between *sensation*—one's ability to detect stimuli in the environment—and *perception*—one's interpretation of stimuli. For reasons you'll discover a bit later, it's virtually impossible to perceive (interpret) everything the body senses. Because learners can handle only so much information at a given time, they must choose a few things to focus on and ignore the rest.

  As an analogy, consider the hundreds of items a typical adult receives in the mail each year, not only in paper form from the post office but also in electronic form through email. Do you open, examine, and respond to every piece of mail? Probably not. Chances are that you process a few key items, inspect other items long enough to know that you don't need them, and discard still others without even opening them.

  In much the same way, students encounter a great deal of new information every day—information delivered by way of teacher instruction, textbooks, bulletin boards, classmates' behaviors, smartphones, and so on. They must inevitably make choices about which pieces of information are important for them. They select a few stimuli to examine and respond to in depth, give other stimuli only a cursory glance, and ignore other stimuli altogether.

- *Meanings and understandings are not derived directly from the environment; instead, they are constructed by the learner.* Like Kanesha, people often create their own unique understandings about a topic—understandings that may or may not be accurate. The process of **construction** lies at the core of many cognitive theories of learning: Learners take numerous, separate pieces of information and use them to create a general understanding, interpretation, or recollection of some aspect of their world (e.g., Brainerd & Reyna, 2005; Lin & He, 2012; Neisser, 1967). Learning theories that focus primarily on the nature of this constructive process are collectively known as **constructivism**. Some constructivist theories focus primarily on how learners idiosyncratically construct knowledge *on their own* (rather than in

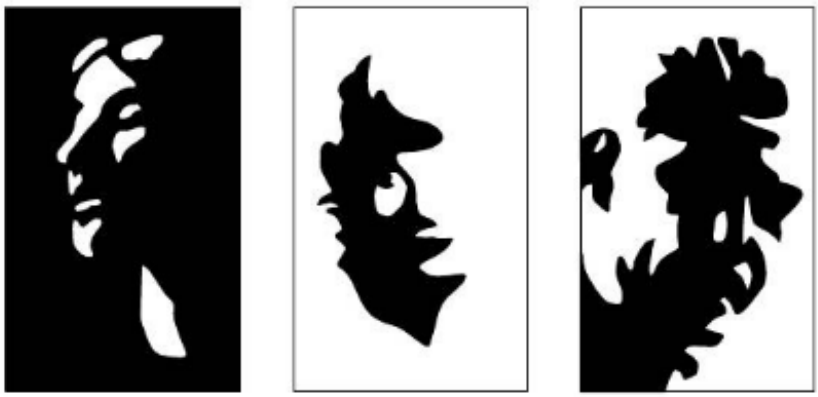
collaboration with other people); such theories fall into a subcategory known as individual constructivism.

To experience the process of construction firsthand, try the following exercise.

EXPERIENCING FIRSTHAND

THREE FACES

Look at the three black-and-white figures shown here. What do you see in each one? Most people perceive the figure on the left to be that of a woman, even though many of her features are missing. Enough features are visible—an eye, parts of the nose, mouth, chin, and hair—that you can construct a meaningful perception from them. Is enough information available in the other two figures for you to construct two more faces? Construction of a face from the figure on the right may take a while, but it can be done.



Source: Figures from "Age in the Development of Closure Ability in Children" by C. M. Mooney, 1957, *Canadian Journal of Psychology, 11*, p. 220. Copyright 1957 by Canadian Psychological Association. Reprinted with permission.

Objectively speaking, the three configurations of black splotches leave a lot to the imagination. The woman in the middle is missing half of her face, and the man on the right is missing the top of his head. Yet knowing what human faces typically look like may have been enough to enable you to mentally add the missing features and perceive complete pictures. Curiously, once you've constructed faces from the figures, they then seem obvious. If you were to close this book now and not pick it up again for a week or more, you would probably see the faces almost immediately, even if you had had considerable difficulty perceiving them originally.

As teachers, we must remember that students won't necessarily learn information exactly as we present it to them. In fact, they'll each interpret classroom subject matter in their own, idiosyncratic ways. And occasionally they may construct *mis*information, as Kanesha does when she counterproductively connects the *sternum* to the stern of a boat.

- *Maturational changes in the brain enable increasingly sophisticated cognitive processes with age.* With the advent of new technologies for studying the brain, psychologists have teamed with experts in neurology and medicine to learn more and more about how the brain functions and how it changes with age and experience. This body of research, known as either neuropsychology or cognitive neuroscience, has enabled cognitive psychologists to test various hypotheses about the precise nature of human learning and thinking. Furthermore, it has revealed that the human brain changes in many significant ways over the course of childhood and adolescence. Such changes are almost certainly one key reason why children become capable of increasingly effective cognitive processes, such as longer attention spans and enhanced ability to organize and integrate information (Atkins, Bunting, Bolger, & Dougherty, 2012; Kuhn, 2006; C. A. Nelson, Thomas, & de Haan, 2006). But rather than propose distinct stages of cognitive development (as Jean Piaget did), most cognitive psychologists believe that children's cognitive development can best be characterized as gradual *trends*. As we proceed through the chapter, we'll identify a number of developmental trends in children's cognitive processes.

Table 6.2 summarizes the assumptions just described and can help you apply them to your own teaching practice.

PRINCIPLES/ASSUMPTIONS

TABLE 6.2 • Basic Assumptions of Cognitive Psychology and Their Educational Implications

ASSUMPTION	EDUCATIONAL IMPLICATION	EXAMPLE
Influence of cognitive processes	Encourage students to think about classroom subject matter in ways that will help them remember it.	When introducing the concept *mammal*, ask students to identify many examples of mammals.
Behavior as a reflection of cognitive processes	Ask students to explain their reasoning, and look closely at what they do and say to make educated guesses about how they are thinking about classroom topics.	When a student says that 16 + 19 = 25 and that 27 + 27 = 44, hypothesize that the student is forgetting to regroup—that is, when she adds 7 + 7, she forgets to carry the 1 in 14 to the tens column—and provide additional instruction about the regrouping process.
Selectivity about what is learned	Help students identify the most important things for them to learn. Also help them understand *why* these things are important.	Give students questions they should try to answer as they read their textbooks. Include questions that ask them to apply what they read to their own lives.
Construction of meanings and understandings	Provide experiences that will help students make sense of the topics they're studying, and regularly monitor students' understandings.	When studying Nathaniel Hawthorne's *The Scarlet Letter*, have students convene in small groups to discuss possible reasons that the Reverend Dimmesdale refuses to acknowledge that he is the father of Hester Prynne's baby.
Increasing capacity for sophisticated cognitive processes with age	Take into account strengths and limitations of students' cognitive processing capabilities at different age levels.	When teaching kindergartners basic counting skills, accommodate their short attention spans by keeping verbal explanations brief and conducting a variety of active, hands-on counting activities.

A Model of Human Memory

Cognitive psychologists have offered many explanations of how people mentally process and remember new information and events—explanations that fall into the general category of information processing theory. Some early explanations portrayed human thinking and learning as being similar to the ways computers operate. It has since become clear, however, that the computer analogy is too simple: People often think about and interpret information in ways that are hard to explain in the relatively simplistic, one-thing-always-leads-to-another ways that are typical for computers (e.g., Hacker, Dunlosky, & Graesser, 2009a; G. Marcus, 2008; Minsky, 2006).

Central to information processing theory is the concept of memory. In some instances we'll use this term to refer to learners' ability to mentally save previously learned knowledge or skills over a period of time. In other instances we'll use it when talking about a particular location where learners put what they learn—perhaps in *working memory* or *long-term memory*.

The process of putting what is being learned into memory is called storage. For example, each time you go to class, you undoubtedly *store* some of the ideas presented in a lecture or class discussion. You may store other information from class as well—perhaps the name of the person sitting next to you (George), the shape and size of the classroom (rectangular, about 15 by 30 meters), or the pattern of the instructor's shirt (a ghastly combination of orange and purple splotches). Yet learners rarely store information exactly as they receive it. Instead, they engage in encoding, modifying the information in some way. For instance, when listening to a story, you might imagine what certain characters look like—thus encoding some verbal input as visual images. And when you see your instructor's orange and purple shirt, you might think, "My instructor desperately needs a wardrobe makeover"—thus assigning a specific *meaning* and *interpretation* to what you've seen.

At some point after storing a piece of information, you may discover that you need to use it. The process of remembering previously stored information—that is, finding it in memory—is called retrieval. The following exercise illustrates this process.

As you probably noticed when you tried to answer these questions, retrieving some kinds of information from memory—your name, for instance—is quick and easy. Other things—perhaps the capital of France (Paris) and the year of Columbus's first voyage across the Atlantic (1492)—can be retrieved only after some thought and effort. Still other pieces of information, even though you may have stored them in memory at one time, may be almost impossible to retrieve. Perhaps the correct spelling of *hors d'oeuvre* falls into this category.

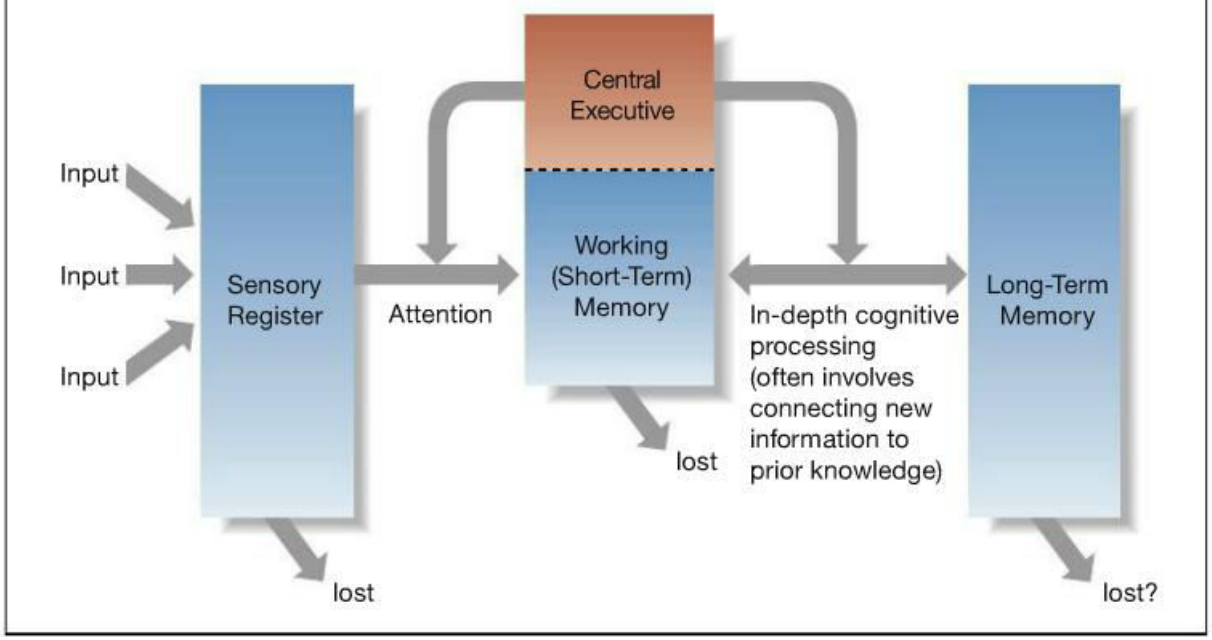
Despite their common use of such terms as *storage, encoding,* and *retrieval,* information processing theorists don't all agree about the precise nature of human memory. However, many suggest that memory has three key components: a sensory register, a working (short-term) memory, and a long-term memory. A three-component model of human memory, based loosely on one proposed by Atkinson and Shiffrin in 1968 with modifications to reflect more recent research findings, is presented in Figure 6.1. The model oversimplifies the nature of memory to some degree (more about this point later), but it provides a good way to organize much of what we know about how memory works.

Please note that in referring to three components of memory, we're *not* necessarily referring to three separate parts of the brain. The model of memory we describe here has been derived largely from studies of human behavior, rather than from studies of the brain.

THE NATURE OF THE SENSORY REGISTER

If you have ever played with a lighted sparkler at night, then you've seen the tail of light that follows a sparkler as you wave it about. If you have ever daydreamed in class, you may have noticed that when you tune back in to a lecture, you can still hear the three or four words that were spoken just *before* you started paying attention to your instructor again. The sparkler's tail and the words

FIGURE 6.1 **A model of the human memory system.**



that linger aren't actually out there in the environment. Instead, they're recorded in your sensory register.

The **sensory register** is the component of memory that holds the information you receive—the *input*—in more or less its original, *un*encoded form. Thus, visual input is stored in a visual form, and auditory input is stored in an auditory form (e.g., Coltheart, Lea, & Thompson, 1974; Cowan, 1995). The sensory register has a *large capacity:* It can hold a great deal of information at any one time.

That's the good news. The bad news is that information stored in the sensory register doesn't last very long (e.g., Cowan, 1995; Dahan, 2010; Wingfield & Byrnes, 1981). Visual information (i.e., what you see) probably lasts for less than a second. For example, one of us authors (Jeanne) can never spell out her entire first name with a sparkler: The *J* always fades before she gets to the first *n,* no matter how quickly she writes in the night air. Auditory information (i.e., what you hear) probably lasts slightly longer, perhaps for 2 or 3 seconds. To keep information for any time at all, then, learners need to move it to *working memory.* Whatever information isn't moved is probably lost, or forgotten.

MOVING INFORMATION TO WORKING MEMORY: THE ROLE OF ATTENTION

Sensory information, such as the light cast by a sparkler, doesn't last very long no matter what we do. But we can preserve a memory of it by encoding it in some minimal way—for instance, by "seeing" (i.e., perceiving) the letters *Jea* in a sparkler's curlicue tail. In the model of memory presented in Figure 6.1, the first step in this process is **attention**: *Whatever someone mentally pays attention to moves into working memory.* If information in the sensory register doesn't get a person's attention, it presumably disappears from the memory system.

Paying attention involves directing not only the appropriate sensory receptors (in the eyes, ears, etc.) but also the *mind* toward whatever needs to be learned and remembered. Imagine yourself reading a textbook for one of your classes. Your eyes are moving down each page, but you're thinking about something altogether different—a recent argument with a friend, a high-paying job advertised on the Internet, or your growling stomach. What will you remember from the textbook? Absolutely nothing. Even though your eyes have been focused on the words in the book, you haven't been *mentally* attending to the words.

Young children's attention often moves quickly from one thing to another and is easily drawn to objects and events unrelated to the task at hand. For example, although decorating walls with colorful pictures and other images can make a kindergarten classroom more appealing for children, a *lot* of colorful décor is likely to distract many kindergartners from their lessons (Fisher, Godwin, & Seltman, 2014). As children grow older, they become better able to focus their attention on a particular task and keep it there, and they're less distracted by irrelevant thoughts and events. Yet even adult learners can't keep their minds on a single task *all* the time (E. Barron, Riby, Greer, & Smallwood, 2011; S. M. Carlson & Moses, 2001; Immordino-Yang, Christodoulou, & Singh, 2012).

Even when learners *are* paying attention, they can attend to only a very small amount of information at any one time. In other words, attention has a *limited capacity* (Cherry, 1953; Cowan, 2007). For example, if you're sitting in front of your television set with your textbook open in your lap, you can attend to a *Big Bang Theory* rerun playing on TV *or* to your book, but not to both simultaneously. And if, in class, you're preoccupied with your instructor's desperate need for a fashion makeover, you're unlikely to be paying attention to the lecture itself.

Exactly *how* limited is the limited capacity of human attention? People can often perform two or three well-learned, automatic tasks at once. For example, you can walk and chew gum simultaneously, and you can probably drive a car and drink a cup of coffee at the same time. But when a stimulus or event is detailed and complex (as both textbooks and *Big Bang Theory* reruns are) or when a task requires considerable thought (as understanding a lecture and driving a car on an icy mountain road would), then people can usually attend to only *one* thing at a time. Despite our best efforts, we human beings are *not* very good at multitasking (Foerde, Knowlton, & Poldrack, 2006; Lien, Ruthruff, & Johnston, 2006).

As teachers, we must remember that attention isn't just a behavior; it's also a mental process. The Into the Classroom feature "Getting and Keeping Students' Attention" presents several effective strategies for keeping students' minds on classroom topics.

THE NATURE OF WORKING (SHORT-TERM) MEMORY

Working memory is the component of human memory where we hold attended-to information for a short time while we try to make sense of it. Working memory is also where much of our active cognitive processing occurs. For instance, it's where we think about the content of a lecture, analyze a textbook passage, or solve a problem. Basically, this is the component that does most of the mental work of the memory system—hence its name, *working* memory.

Rather than being a single entity, working memory probably has several components for holding and working with different kinds of information—for example, visual information, auditory information, and the underlying meanings of events—as well as a component that integrates multiple kinds of information. As shown in Figure 6.1, working memory may also include a **central executive** that focuses attention, oversees the flow of information throughout the memory system, selects and controls complex voluntary behaviors, and inhibits counterproductive thoughts and actions (Baddeley, 2001; Banich, 2009; Logie, 2011). Such processes—collectively known as **executive functions**—improve over the course of childhood and adolescence (largely as a result of brain maturation) and significantly enhance students' academic performance (Atkins et al., 2012; J. R. Best & Miller, 2010; Masten et al., 2012).

Information stored in working memory doesn't last very long—perhaps 5 to 20 seconds at most—unless the learner consciously does something with it (e.g., Baddeley, 2001; L. R. Peterson & Peterson, 1959; W. Zhang & Luck, 2009). Accordingly, this component is sometimes called *short-term memory*. For example, imagine that you need to call a neighbor, so you look up the neighbor's number in a telephone directory. Because you've paid attention to the number, it's presumably in your working memory. But then you discover that you can't find your cell phone. You have no paper and pencil handy. What do you do to remember the number until you have access to a phone?

If you're like most people, you probably repeat it to yourself over and over again. This process, known as maintenance rehearsal, keeps information in working memory for as long as you're willing to continue talking to yourself. But once you stop, the number will disappear fairly quickly.

The amount of information children can hold in working memory increases a bit with age, probably as a result of both brain maturation and the acquisition of more effective cognitive processes (Barrouillet & Camos, 2012; Ben-Yehudah & Fiez, 2007; Kail, 2007). Yet even adults have only so much "room" to simultaneously hold and think about information. To see what we mean, put your working memory to work for a moment in the following exercise.

EXPERIENCING FIRSTHAND
DIVISION PROBLEM

Try computing the answer to this division problem in your head:

$$59\overline{)49{,}383}$$

Did you find yourself having trouble remembering some parts of the problem while you were dealing with other parts? Did you ever arrive at the correct answer of 837? Most people can't solve a division problem with this many digits unless they write it down. Working memory just doesn't have enough space both to hold all that information and to perform mathematical calculations with it. Like attention, working memory has a *limited capacity*—perhaps just enough for a telephone number or very short grocery list (Cowan, 2010; Logie, 2011; G. A. Miller, 1956).

Virtually any learning activity imposes a cognitive load—a certain amount of information that learners must simultaneously think about, along with certain *ways* that they must think about it, in order to make sense of and remember what they're studying (R. E. Mayer, 2011b; Plass, Moreno, & Brünken, 2010; Sweller, 1988, 2008). As teachers, then, when we design and conduct lessons, we must consider just how much of a load students' working memories can reasonably handle at any given time. For example, we should minimize information that's irrelevant to the topic at hand. We should pace the presentation of important information slowly enough that students have time to effectively process what they're seeing and hearing. And we might repeat the same idea several times (perhaps rewording it each time), stop to write important points on the board, and provide several examples and illustrations.

We authors sometimes hear students talking about putting class material in "short-term memory" so that they can do well on an upcoming exam. Such a statement reflects the common misconception that this component of memory lasts for several hours, days, or weeks. Now you know otherwise. Working memory is obviously *not* the place to leave information that you need for an exam later in the week or even information you need for a class later in the day. For such information, storage in long-term memory—the final component of the memory system—is in order.

MOVING INFORMATION TO LONG-TERM MEMORY: CONNECTING NEW INFORMATION WITH PRIOR KNOWLEDGE

In the model of memory depicted in Figure 6.1, the arrow between working memory and long-term memory points in both directions. Effectively storing new information in long-term memory usually involves connecting it to relevant information that's *already* in long-term memory—a process that requires bringing the "old" information back into working memory. The following exercise can give you an idea of how this might happen.

No doubt the second letter string was easier to learn because you could relate it to something you already knew: the words *familiar words.* How easily were you able to learn and remember the picture? Do you think you could draw it from memory a week from now? Do you think you could remember it more easily if it had the title "Bird's Eye View of a Cowboy Riding a Bicycle"? The answer to the last question is almost certainly yes, because the title would help you relate the picture to familiar shapes, such as those of a bicycle and a cowboy hat (e.g., see Bower, Karlin, & Dueck, 1975).

THE NATURE OF LONG-TERM MEMORY

Long-term memory is where learners store their general knowledge and beliefs about the world, the things they've learned from formal instruction (e.g., the capital of France, the correct spelling of *hors d'oeuvre*), and their recollections of events in their personal lives. It's also where learners store their knowledge about how to perform various actions, such as how to dribble a basketball, use a cell phone, and do long division.

Much of the information stored in long-term memory is interconnected. To see what we mean, try the next exercise.

EXPERIENCING FIRSTHAND
STARTING WITH A HORSE

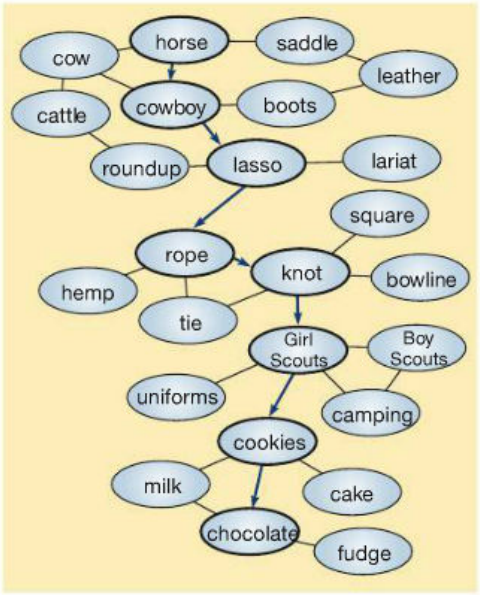
What's the first word that comes to mind when you see the word *horse?* And what word does that second word remind you of? And what does the third word remind you of? Beginning with the word *horse,* follow your train of thought, letting each word remind you of a new word or short phrase, for a sequence of at least eight words or phrases. Write down the sequence of things that come to mind.

You probably found yourself easily following a train of thought from the word *horse,* perhaps something like the route that one of us authors followed:

horse → cowboy → lasso → rope → knot → Girl Scouts → cookies → chocolate

The last word in your sequence might be one with little or no obvious relationship to horses. Yet you can probably see a logical connection between each pair of items in the sequence. Related pieces of information tend to be associated with one another in long-term memory, perhaps in a network similar to the one depicted in Figure 6.2.

FIGURE 6.2 A possible train of thought from *horse* to *chocolate*.



Information stored in long-term memory lasts much, much longer than information stored in working memory—perhaps it lasts a day, a week, a month, a year, or a lifetime, depending on a variety of factors that we'll examine in upcoming sections of the chapter. In addition to its indefinitely long duration, long-term memory seems to be capable of holding as much information as a learner needs to store there. There's probably no such thing as "running out of room." In fact, for reasons you'll discover shortly, the more information already stored in long-term memory, the easier it is to learn new things.

LEARNING, MEMORY, AND THE BRAIN

Historically, theorists and researchers have believed that the physiological basis for most learning and memory lies in changes in the interconnections among neurons—in particular, in forming new synapses, strengthening existing ones, or eliminating counterproductive ones (e.g., M. I. Posner & Rothbart, 2007; Siegel, 2012; Trachtenberg et al., 2002). In addition, some learning may involve the formation of new neurons, especially in a small, seahorse-shaped structure in the middle of each side of the brain—a structure called the *hippocampus*—and possibly also in certain areas of the cortex. New learning experiences appear to enhance the survival rate and maturation of the young neurons; without such experiences, these neurons slowly die away (Leuner et al., 2004; C. A. Nelson et al., 2006; Spalding et al., 2013).

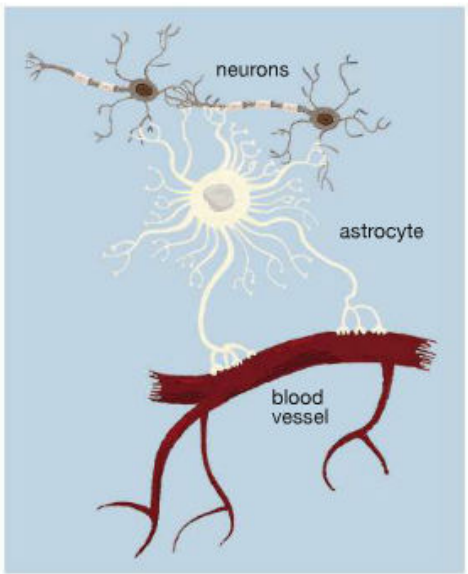
Within the last few years, some researchers have begun to speculate that certain star-shaped cells in the brain, known as astrocytes, are just as important as neurons—possibly even more important—in learning and memory. Figure 6.3 illustrates the general nature of an astrocyte and its connections with both neurons and the local blood supply. In human beings, astrocytes far outnumber neurons, have many connections with one another and with neurons, and appear to have considerable control over what neurons do and don't do and how much neurons communicate with one another. A normal brain produces many new astrocytes throughout its life span (X. Han et al., 2013; Koob, 2009; Oberheim et al., 2009).

Astrocytes are one variety of the brain's glial cells, described in Chapter 2.

As for *where* learning occurs, the answer is: many places. Key in the process is the *cortex*, the large, lumpy structure that covers the top and sides of the brain. The part of the cortex that's right behind the forehead—the *prefrontal cortex*—seems to be the primary headquarters for working memory and its central executive, although all of the cortex may be active to a greater or lesser extent in interpreting new input in light of previously acquired knowledge (Chein & Schneider, 2012; Gonsalves & Cohen, 2010; Huey, Krueger, & Grafman, 2006; Nee, Berman, Moore, & Jonides, 2008). The hippocampus is also actively involved in learning, in that it pulls together the information it simultaneously receives from various parts of the brain (Bauer, 2002; Squire & Alvarez, 1998).

As you might guess, a healthy brain is essential for effective learning. The Applying Brain Research feature "Enhancing Students' Brain Functioning" presents four general recommendations that are grounded in brain research.

FIGURE 6.3 Two neurons, an astrocyte, and their interconnections.



CRITIQUING THE THREE-COMPONENT MODEL

As mentioned earlier, the three-component model just described oversimplifies—and probably overcompartmentalizes—the nature of human memory. For example, attention may be an *integral part* of working memory, rather than the separate entity depicted in Figure 6.1 (Cowan, 2007; Kiyonaga & Egner, 2014; Oberauer & Hein, 2012). Furthermore, studies conducted by neuropsychologists and other researchers have yielded mixed results about whether working memory and long-term memory are distinctly different entities (e.g., Baddeley, 2001; Nee et al., 2008; Öztekin, Davachi, & McElree, 2010; Talmi, Grady, Goshen-Gottstein, & Moscovitch, 2005).

Some psychologists have proposed that working memory and long-term memory simply reflect different activation states of a single memory (e.g., J. R. Anderson, 2005; Cowan, 1995; Ruchkin, Grafman, Cameron, & Berndt, 2003). According to this view, all information stored in memory is in either an active or inactive state. Active information, which may include both incoming information and information previously stored in memory, is what people are currently paying attention to and thinking about—information we've previously described as being in working memory. As attention shifts, other pieces of information in memory become activated, and the previously activated information gradually becomes inactive. The bulk of information stored in memory is in an inactive state, such that people aren't consciously aware of it; this is information we've previously described as being in long-term memory.

Despite its imperfections, the three-component model can help us remember aspects of human learning and memory that we teachers should take into account as we plan and teach lessons. For example, the model highlights the critical role of *attention* in learning, the *limited capacity* of attention and working memory, the *interconnectedness* of the knowledge learners acquire, and the importance of *relating* new information to things learned previously.

MyEdLab **Self-Check 6.2**

MyEdLab **Application Exercise 6.1.** In this exercise, you can apply your knowledge of memory's key components to various classroom scenarios.

Long-Term Memory Storage

Regardless of whether there are three truly distinct components of memory, we human beings remember a great many things for a considerable length of time—often for our entire life spans. In this sense, at least, a good deal of what we know and can do is in long-term memory.

It appears that information stored in long-term memory can be encoded in a variety of forms (e.g., Barsalou, Simmons, Barbey, & Wilson, 2003; Brainerd & Reyna, 2005; Sadoski & Paivio, 2001). Some information may be encoded in a *verbal* form, perhaps as actual words. Things you remember word for word (e.g., your name, your address, certain song lyrics) are all verbally encoded. Other information may be encoded as *imagery*—as it appears perceptually. For example, if, in your mind, you can see the face of a relative, hear that person's voice, or conjure up a mental whiff of the person's favorite perfume or aftershave lotion, you're retrieving images. Finally, a great deal of information in long-term memory is probably encoded *semantically*—as a set of underlying meanings.

All of the preceding examples are instances of declarative knowledge—knowledge that relates to the nature of *how things are, were, or will be.* Declarative knowledge encompasses both general world knowledge (collectively known as *semantic memory*) and recollections of specific life experiences (collectively known as *episodic memory*). Not everything in long-term memory is declarative in nature, however. People also acquire procedural knowledge; that is, they learn *how to do things* (e.g., J. R. Anderson, 1983; Phye, 1997; Tulving, 1983). You probably know how to ride a bicycle, wrap a birthday present, and multiply a three-digit number by a two-digit number. To perform such actions successfully, you must adapt your behavior to changing conditions. For example, when you ride a bike, you must be able to turn left or right when an object blocks your path, and you must be able to come to a complete stop when you reach your destination. Accordingly, procedural knowledge often includes information about how to respond under different circumstances—it involves knowing *when to do certain things* (either physically or mentally). In such instances it's also known as conditional knowledge.

Most declarative knowledge is explicit knowledge: Once we recall it, we're quite conscious of what it is we know. But a good deal of procedural knowledge is implicit knowledge: We can't consciously recall or explain it, but it affects our thinking or behavior nonetheless (P. A. Alexander, Schallert, & Reynolds, 2009; J. R. Anderson, 2005; M. I. Posner & Rothbart, 2007). Another difference is that declarative knowledge can sometimes be learned very quickly, perhaps after a single presentation, whereas procedural knowledge is often acquired slowly and only with considerable practice.

HOW KNOWLEDGE CAN BE ORGANIZED

As we consider the nature of long-term memory storage, it's helpful to remember that, to a considerable degree, learners *construct* their knowledge and understandings. In the process of constructing knowledge, learners often create well-integrated entities that encompass particular ideas or groups of ideas. For example, beginning in infancy, human beings form **concepts** that enable them to categorize objects and events (G. Mandler, 2011; J. M. Mandler, 2007; Quinn, 2002). Some concepts, such as *butterfly, chair,* and *backstroke,* refer to a fairly narrow range of objects or events. Other concepts are fairly general ones that encompass many more-specific concepts. For example, the concept *insect* includes ants, bees, and butterflies (e.g., see Figure 6.4). The concept *swimming* includes the backstroke, dog paddle, and butterfly. As you can see, some words (such as *butterfly*) can be associated with two very different, more general concepts (such as *insects* and *swimming*) and so might lead someone to follow a train of thought such as this one:

horse → cowboy → lasso → rope → knot → Girl Scouts → camping
→ outdoors → nature → insect → butterfly → swimming

By combining numerous objects or events into single entities, concepts take some of the strain off of working memory's limited capacity (G. Mandler, 2011; Oakes & Rakison, 2003). For instance, the concept *molecule* takes very little "space" in working memory despite the many things we know about molecules, such as their composition and very tiny size. The Into the Classroom feature "Teaching Concepts" offers suggestions for fostering concept learning in a variety of academic disciplines.

Learners also pull some concepts together into general understandings of what things are typically like. Such understandings are sometimes called **schemas** (e.g., Rumelhart & Ortony, 1977; Schraw, 2006; Sweller, 2010). For example, let's return once again to the concept *horse.* You know what horses look like, of course, and you can recognize one when you see one. Hence, you have a concept for *horse.* But now think about the many things you know *about* horses. What do they eat? How do they spend their time? Where are you most likely to see them? You can probably retrieve many facts about horses, perhaps including their fondness for oats and carrots, their love of grazing and running, and their frequent appearance in pastures and at racetracks. The various things you know about horses are closely interrelated in your long-term memory in the form of a "horse" schema.

People have schemas not only about objects but also about events. When a schema involves a predictable sequence of events related to a particular activity, it's sometimes called a **script.** The next exercise provides an example.

EXPERIENCING FIRSTHAND
JOHN

Read the following passage *one time only*.

> John was feeling bad today so he decided to go see the family doctor. He checked in with the doctor's receptionist, and then looked through several medical magazines that were on the table by his chair. Finally the nurse came and asked him to take off his clothes. The doctor was very nice to him. He eventually prescribed some pills for John. Then John left the doctor's office and headed home. (Bower, Black, & Turner, 1979, p. 190)

You probably had no trouble making sense of the passage because you've been to a doctor's office yourself and have a schema for how those visits usually go. You can therefore fill in a number of details that the passage doesn't tell you. For example, you probably inferred that John actually *went* to the doctor's office, although the story omits this essential step. Likewise, you probably concluded that John took off his clothes in the examination room, *not* in the waiting room, even though the story doesn't tell you where John did his striptease. When critical information is missing, as is true in the story about John, schemas and scripts often enable learners to fill in the gaps in a reasonable way.

On a much larger scale, human beings—young children included—construct general understandings and belief systems, or theories, about particular aspects of the world (Gelman, 2003; Keil & Newman, 2008; Wellman & Gelman, 1998). Such theories include many concepts and the relationships among them (e.g., correlation, cause–and–effect). To see what some of your own theories are like, try the next exercise.

EXPERIENCING FIRSTHAND
COFFEEPOTS AND RACCOONS

Consider each of the following situations:


A


B

1. People took a coffeepot that looked like Drawing A. They removed the handle, sealed the top, took off the top knob, sealed the opening to the spout, and removed the spout. They also sliced off the base and attached a flat piece of metal. They attached a little stick, cut out a window, and filled the metal container with birdseed. When they were done, it looked like Drawing B. After these changes, was this a coffeepot or a bird feeder?


C


D

2. Doctors took the raccoon in Drawing C and shaved away some of its fur. They dyed what was left black and then bleached a single white stripe down the center of the animal's back. Then, with surgery, they put in its body a sac of super-smelly odor, just like the smell a skunk has. After they were all done, the animal looked like Drawing D. After the operation, was this a skunk or a raccoon?

(Both scenarios based on Keil, 1989, p. 184)

Chances are, you concluded that the coffeepot was transformed into a bird feeder but that the raccoon was still a raccoon despite its cosmetic makeover and stinky surgery. Now how is it possible that the coffeepot could be made into something entirely different, whereas the raccoon could not? Even young children seem to make a basic distinction between human-made objects (e.g., coffeepots, bird feeders) and biological entities (e.g., raccoons, skunks) (Gelman & Kalish, 2006; Inagaki & Hatano, 2006; Keil, 1986, 1989). For instance, human-made objects are defined

largely by the *functions* they serve (e.g., brewing coffee, feeding birds), whereas biological entities are defined primarily by their origins (e.g., the parents who brought them into being, their DNA). Thus, when a coffeepot begins to hold birdseed rather than coffee, it becomes a bird feeder because its function has changed. But when a raccoon is cosmetically and surgically altered to look and smell like a skunk, it still has raccoon parents and raccoon DNA and so can't possibly *be* a skunk.

By the time children reach school age, they've already constructed basic theories about their physical, biological, social, and psychological worlds (Flavell, 2000; Geary, 2005; Torney-Purta, 1994; Wellman & Gelman, 1998). They've also constructed preliminary theories about the nature of their own and other people's thinking. In general, self-constructed theories help children make sense of and remember personal experiences, classroom subject matter, and other new information (Gelman, 2003; Reiner, Slotta, Chi, & Resnick, 2000; Wellman & Gelman, 1998). Yet because children's theories often evolve with little or no guidance from more knowledgeable individuals, they sometimes include erroneous beliefs about the world that can wreak havoc with new learning (more about this point later in the chapter).

HOW DECLARATIVE KNOWLEDGE IS LEARNED

Especially when talking about the kinds of declarative knowledge acquired at school, learning theorists distinguish between two general forms of long-term memory storage processes—rote learning and meaningful learning—and among more specific storage processes that differ considerably in their effectiveness (see Table 6.3).

ROTE LEARNING

Learners engage in rote learning when they try to learn and remember something without attaching much meaning to it. For example, in the "Letters and a Picture" exercise presented earlier, you would be engaging in rote learning if you tried to remember the letter string FAMILIARWORDS simply as a list of isolated letters or if you tried to remember the cowboy/bicycle drawing as a collection of random, unrelated lines and curves.

One common form of rote learning is rehearsal, repeating something over and over within a short time frame (typically a few minutes or less), either by saying it aloud or by continuously thinking about it in an unaltered, verbatim fashion. Earlier we described how maintenance rehearsal—verbally repeating something over and over—helps us keep information in working memory indefinitely. Contrary to what many students think, however, rehearsal is *not* a very effective way of storing information in *long-term* memory. If a learner repeats something often enough, it might eventually "sink in," but the process is slow, laborious, and not much fun. Furthermore, for reasons we'll identify later, people who use rehearsal and other forms of rote learning often have trouble remembering what they've learned (J. R. Anderson, 2005; Craik & Watkins, 1973; McDermott & Naaz, 2014).

COMPARE/CONTRAST

TABLE 6.3 • Long-Term Memory Storage Processes

PROCESS	DEFINITION	EXAMPLE	EFFECTIVENESS
Rote learning: Learning primarily through repetition and practice, with little or no attempt to make sense of what is being learned			
Rehearsal	Repeating information verbatim, either mentally or aloud	Word-for-word repetition of a formula or definition	Relatively ineffective: Storage is slow, and later retrieval is difficult
Meaningful learning: Making connections between new information and prior knowledge			
Elaboration	Embellishing on new information based on what one already knows	Generating possible reasons that prominent people in history made the decisions they did	Effective if associations and additions made are accurate and productive
Organization	Making connections among various pieces of new information	Thinking about how one's lines in a play relate to the play's overall story line	Effective if organizational structure is legitimate and consists of more than just a list of discrete facts
Visual imagery	Forming a mental picture of something, either by actually seeing it or by envisioning how it might look	Imagining how various characters and events in a novel might have looked	Individual differences in effectiveness; especially beneficial when used in combination with elaboration or organization

Verbally rehearsing information is probably better than not actively processing it at all, and rehearsal may be one of the few strategies students can use when they have little prior knowledge to draw on to help them understand new material (E. Wood, Willoughby, Bolger, & Younger, 1993). For example, in the opening case study Kanesha resorts to rehearsal in her efforts to remember such seemingly nonsensical bone names as the coccyx, clavicle, and patella. Ideally, however, we should encourage students to engage in meaningful learning whenever possible.

MEANINGFUL LEARNING

In contrast to rote learning, meaningful learning involves recognizing a relationship between new information and something already stored in long-term memory. Whenever we use such words as *comprehension* and *understanding*, we're talking about meaningful learning. In the vast majority of cases, meaningful learning is more effective than rote learning for storing information in long-term memory (R. E. Mayer, 1996; Sweller, 2010; Wittrock, 1974). It's especially effective when learners relate new ideas not only to what they already know about the world but also to what they know or believe about *themselves*—for instance, to self-descriptions or personal life experiences (Heatherton, Macrae, & Kelley, 2004; Kesebir & Oishi, 2010; Rogers, Kuiper, & Kirker, 1977).

Meaningful learning takes a variety of forms. Three forms that researchers have studied in depth are elaboration, organization, and visual imagery. All three are *constructive* in nature: They involve combining several pieces of information into a meaningful whole.

Elaboration. In elaboration, learners use their prior knowledge to embellish on a new idea, thereby storing *more* information than was actually presented. For example, when one of us authors took a course in Mandarin Chinese in high school, she learned that the Chinese word *wǒmen* means "we." "Aha!" she thought to herself, "the sign on the restroom that *we* girls use says *wǒmen*" (albeit without the tone mark over the *o*). Similarly, a student who reads that a certain species of dinosaurs had powerful jaws and sharp, pointed teeth might correctly deduce that those dinosaurs were meat eaters. And when a student learns that the crew on Columbus's first trip across the Atlantic threatened to revolt, the student might speculate, "I bet the men were really frightened when they continued to travel west day after day without ever seeing signs of land."

As we'll see later in the chapter, learners sometimes elaborate on new information in inaccurate and counterproductive ways. On average, however, the more students elaborate on new material—that is, the more they use what they already know to help them understand and interpret new material—the more effectively they will store and remember it. Thus, students who regularly elaborate on what they learn in school usually show higher achievement than those who simply take information at face value (J. R. Anderson, 2005; McDaniel & Einstein, 1989; Paxton, 1999; Waters, 1982).

One effective way to encourage elaboration in the classroom is to have students talk or write about a topic—for instance, to summarize what they've learned, relate new concepts to their personal experiences, or express and defend certain positions on controversial topics (e.g., Bangert-Drowns, Hurley, & Wilkinson, 2004; Shanahan, 2004). Another good strategy is to ask questions that require students to expand on something they've just learned—questions such as "How would you use . . . to . . . ?" and "What do you think would happen if . . . ?" (A. King, 1992, p. 309; McCrudden & Schraw, 2007). Still another approach is to have students work in pairs or small groups to formulate and answer their *own* elaborative questions. Different researchers call such group questioning either *elaborative interrogation* or *guided peer questioning* (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; A. King, 1994, 1999; Ozgungor & Guthrie, 2004). In the following dialogue, fifth graders Katie and Janelle are working together to study class material about tide pools. Katie's job is to ask Janelle questions that encourage elaboration:

Katie: How are the upper tide zone and the lower tide zone different?

Janelle: They have different animals in them. Animals in the upper tide zone and splash zone can handle being exposed—have to be able to use the rain and sand and wind and sun—and they don't need that much water and the lower tide animals do.

Katie: And they can be softer 'cause they don't have to get hit on the rocks.

Janelle: Also predators. In the spray zone it's because there's predators like us people and all different kinds of stuff that can kill the animals and they won't survive, but the lower tide zone has not as many predators.

Katie: But wait! Why do the animals in the splash zone have to survive? (A. King, 1999, p. 97)

Notice that the two girls are continually relating the animals' characteristics to survival in different tide zones, and eventually Katie asks why animals in the splash zone even *need* to survive. Such analyses are quite sophisticated for fifth graders. Just imagine what high school students might be able to do as they become increasingly capable of abstract and hypothetical thinking!

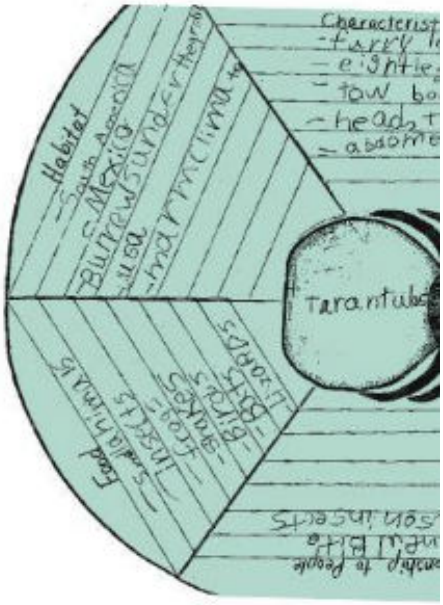
Organization. On average, we humans learn and remember a body of new information more easily when we pull it together in some reasonable way (e.g., McNamara & Magliano, 2009; Nesbit & Adesope, 2006; D. H. Robinson & Kiewra, 1995). Such organization involves making connections among various pieces of new information and forming an overall cohesive structure. For example, a learner might group information into categories, as you probably did in the "Remembering 12 Words" exercise near the beginning of the chapter.

An even better way of organizing information is to identify interrelationships among its various parts. For instance, when learning about *velocity, acceleration, force,* and *mass* in a physics class, a student might better understand these concepts by seeing how they're interconnected—perhaps by learning that velocity is the product of acceleration and time ($v = a \times t$) and that an object's force is determined by both its mass and its acceleration ($f = m \times a$). The trick is not simply to memorize the formulas (that would be rote learning) but rather to make sense of the relationships that the formulas represent.

It's often helpful to give students specific structures they can use to organize information. For example, the weblike note-taking form shown in Figure 6.5 can help elementary students organize what they learn about tarantulas. Another effective structure is a two-dimensional matrix or table that enables students to compare several items with respect to various characteristics—for instance, how various geographical regions differ in topography, climate, economic activities, and cultural practices (R. K. Atkinson et al., 1999; Kiewra, DuBois, Christian, & McShane, 1988; D. H. Robinson & Kiewra, 1995). A third approach is to teach students how to create concept maps—diagrams that depict the concepts of a unit and their interrelationships (Hattie, 2009; Nesbit & Adesope, 2006; Novak, 1998). Figure 6.6 shows concept maps that two different students might construct after a lesson about gorillas. The concepts themselves are circled, and their interrelationships are indicated by lines with words or short phrases. Several concept-mapping software programs (e.g., Kidspiration, MindMapper Jr.) are available for creating and modifying concept maps quickly and easily.

Not only can self-constructed organizational structures help students learn more effectively, but they can also help teachers *assess* students' learning. For example, the concept map on the left side of Figure 6.6 reveals only spotty, fragmented knowledge about gorillas. Furthermore, the student has two ideas that need correction. First, contrary to a common stereotype, gorillas don't regularly swing from trees, although young ones may occasionally climb a tree to escape danger. Second, gorillas aren't especially "fierce" creatures. For the most part, they live a peaceful existence within their family group; they get nasty (e.g., by beating their chests) only when an unfamiliar human being, non-family-member gorilla, or other potential encroacher threatens their territory.

FIGURE 6.5 Using a form his provided, 7-year-old Tony org about tarantulas.



Visual imagery. Earlier we mentioned imagery as one possible way in which information might be encoded in

long-term memory. Many research studies have shown that visual imagery—forming mental pictures of objects or ideas—can be a highly effective method of storing information (Sadoski & Paivio, 2001; D. L. Schwartz & Heiser, 2006; Urgolites & Wood, 2013). To show you how effective visual imagery can be, the next exercise will teach you a few words in Mandarin Chinese.

EXPERIENCING FIRSTHAND
FIVE CHINESE WORDS

Try learning these five Chinese words by forming the visual images we describe (don't worry about learning the tone marks over the words):

Chinese Word	English Meaning	Image
fáng	house	Picture a *house* with *fangs* growing on its roof and walls.
mén	door	Picture a restroom *door* with the word *MEN* painted on it.
kè	guest	Picture someone giving someone else (the *guest*) a *key* to the house.
fàn	food	Picture a plate of *food* being cooled by a *fan*.
shū	book	Picture a *shoe* with a *book* sticking out of it.

Now find something else to do for a couple of minutes. Stand up and stretch, get a glass of water, or use the restroom. But be sure to come back to your reading in just a minute or two.

Now that you're back, cover the list of Chinese words, English meanings, and visual images. Then try to remember what each word means:

kè fàn mén fáng shū

DEVELOPMENTAL TRENDS IN STORAGE PROCESSES FOR DECLARATIVE INFORMATION

Meaningful learning—relating new information to prior knowledge—probably occurs in one form or another at virtually all age levels. More specific strategies—such as rehearsal, organization, and visual imagery—are fairly limited in the early elementary years but increase in both frequency and effectiveness over the course of childhood and adolescence. The frequency of elaboration—especially as a process that learners *intentionally* use—picks up a bit later, often not until adolescence, and is more common in high-achieving students. Table 6.4 provides more detailed information on the nature of long-term memory storage processes at different grade levels.

HOW PROCEDURAL KNOWLEDGE IS LEARNED

Some of the procedures people learn—for example, baking a cake, serving a volleyball, and driving a car with a stick shift—consist primarily of overt behaviors. Many others—for example, writing a persuasive essay, solving for x in an algebraic equation, and surfing the Internet—have a significant mental component as well. Many procedures involve a combination of physical behaviors and mental activities.

Procedural knowledge ranges from relatively simple actions (e.g., using scissors or correctly holding a pencil) to far more complex skills. Complex procedures usually aren't learned in one fell swoop. Instead, they're acquired slowly over a period of time, often only with a great deal of practice (Ericsson, 2003; Macnamara, Hambrick, & Oswald, 2014; Proctor & Dutta, 1995).

People appear to learn simple physical procedures primarily as actual behaviors—in other words, as specific actions that, with practice, are strengthened and gradually refined (Ennis & Chen, 2011; Féry & Morizot, 2000; Willingham, 1999). Yet many complex skills, especially those that have a mental component, may also be learned as declarative knowledge—in other words, as *information* about how to do something (J. R. Anderson, 1983; Baroody, Eiland, Purpura, & Reid, 2013; Beilock & Carr, 2004). Learners may initially use their declarative knowledge to guide them as they perform a new skill, but to the extent that they must do so, their performance is apt to be slow and laborious and to require a lot of concentration—that is, it can consume considerable working memory capacity. As learners continue to practice the skill, their declarative knowledge gradually evolves into procedural knowledge, perhaps eventually to the point that they can perform the activity quickly, efficiently, and effortlessly (we'll look at such *automaticity* more closely a bit later). People who show exceptional talent in a particular skill domain—say, in figure skating or playing the piano—typically practice a great deal, often a minimum of 3 to 4 hours a day over a period of 10 years or more (Ericsson, 1996; Horn, 2008).

Some of the storage processes we've already discussed play a role in acquiring procedural knowledge as well as declarative knowledge. For instance, verbally rehearsing a sequence of

steps in a motor skill enhances people's ability to perform the skill (Weiss & Klint, 1987). Illustrations or live demonstrations of a procedure, which presumably foster visual imagery, are also beneficial (Kitsantas, Zimmerman, & Cleary, 2000; SooHoo, Takemoto, & McCullagh, 2004; Zimmerman & Kitsantas, 1999). In fact, imagining *oneself* performing a new skill (e.g., executing a basketball shot or gymnastics move) can enhance acquisition of the skill, although this strategy obviously isn't as effective as actual practice (Feltz, Landers, & Becker, 1988; Kosslyn, 1985; SooHoo et al., 2004).

Perhaps the most effective way to teach new procedures is to model them for students, including both the overt behaviors and the internal thought processes involved (e.g., Rittle-Johnson, 2006; Schunk, 1998). The Into the Classroom feature "Helping Students Acquire New Procedures" illustrates several additional strategies for facilitating procedural learning.

ROLES OF PRIOR KNOWLEDGE AND WORKING MEMORY IN LONG-TERM MEMORY STORAGE

Students are more likely to engage in meaningful learning when they have a relevant knowledge base—that is, when they have existing knowledge to which they can connect whatever new information and skills they're trying to master. When, in contrast, they have little relevant knowledge on which to build, they're apt to struggle in their efforts to make sense of new material, as Kanesha sometimes does while studying bone names for her biology quiz.

Occasionally students' prior knowledge interferes with something they need to learn; this is the case when Kanesha tries to remember where the sternum is located. In general, however, a relevant knowledge base helps students learn and remember new material more effectively than they would otherwise (e.g., P. A. Alexander, Kulikowich, & Schulze, 1994; Booth & Newton, 2012; Kintsch, 2009). For example, students will better understand scientific principles if they've already seen those principles in action either in their personal lives or in the classroom, and they'll better understand how large some dinosaurs were if they have previously seen life-sized dinosaur skeletons at a natural history museum.

Students' prior knowledge contributes to their learning in several ways:

- It helps them determine what is most important to learn and therefore helps them direct their *attention* appropriately.
- It enhances their ability to *elaborate* on information—for example, to fill in missing details, clarify ambiguities, and draw inferences.
- It provides a framework for *organizing* new information. (Bjorklund, Muir-Broaddus, & Schneider, 1990; Haskell, 2001; Rumelhart & Ortony, 1977; P. T. Wilson & Anderson, 1986)

Children's knowledge about the world grows by leaps and bounds every year; on average, then, older students have more knowledge to help them understand and elaborate on new ideas and events than younger ones do. When young children have more knowledge than their elders, however, they often have the upper hand (Chi, 1978; Flavell, Miller, & Miller, 2002; Kail, 1990; Rabinowitz & Glaser, 1985).

Children don't all acquire the *same* knowledge bases, of course, and their differing knowledge can lead them to construct different meanings from the same situation. The next exercise illustrates this point.

EXPERIENCING FIRSTHAND

ROCKY

Read the following passage *one time only:*

> Rocky slowly got up from the mat, planning his escape. He hesitated a moment and thought. Things were not going well. What bothered him most was being held, especially since the charge against him had been weak. He considered his present situation. The lock that held him was strong but he thought he could break it. He knew, however, that his timing would have to be perfect. Rocky was aware that it was because of his early roughness that he had been penalized so severely—much too severely from his point of view. (R. C. Anderson, Reynolds, Schallert, & Goetz, 1977, p. 372)

Now summarize what you've just read in two or three sentences.

What did you think the passage was about? A prison escape? A wrestling match? Or perhaps something else altogether? When a longer version of this passage was used in an experiment with college students, many physical education majors interpreted it as a wrestling match, but music education majors—most of whom had little or no knowledge of wrestling—were more likely to think it was about a prison break (R. C. Anderson et al., 1977).

Yet it isn't enough that students have the knowledge they need to make sense of new material. They must also be *aware* that some of their existing knowledge is relevant. They must retrieve that knowledge from long-term memory while thinking about the new material, so that *they have both the old and the new in working memory at the same time and thus can make the appropriate connections* (Bellezza, 1986; Glanzer & Nolan, 1986; Kalyuga, 2010).

As teachers, we should use students' existing knowledge as a starting point whenever we introduce a new topic. Furthermore, we should explicitly remind students of things they know that bear directly on a topic of classroom study—an instructional strategy known as **prior knowledge activation** (Machiels-Bongaerts, Schmidt, & Boshuizen, 1993; Resnick, 1989; Spires & Donley, 1998). For instance, we might begin a first-grade unit about plants by asking students to describe what their parents do to keep flowers or vegetable gardens growing. In a secondary English literature class, we might introduce Sir Walter Scott's *Ivanhoe* (in which Robin Hood is a major character) by asking students to tell the tale of Robin Hood as they know it. We should also remember that students from diverse cultural backgrounds may have somewhat different knowledge bases, and adjust our starting points accordingly (E. Fox, 2009; Nelson-Barber & Estrin, 1995; Pritchard, 1990).

Furthermore, we should encourage students to retrieve relevant knowledge *on their own* as they study. One approach is to model this strategy for students. For example, we might read aloud a portion of a textbook, stopping occasionally to tie an idea in the text to something previously studied in class or to something in our own personal experience. We can then encourage students to do likewise, giving suggestions and guiding their efforts as they proceed. Especially when working with students in the elementary grades, we might also want to provide specific questions that encourage students to reflect on their existing knowledge and beliefs as they read and study—for instance, asking themselves, "What do I already know about this topic?" and "Might I discover that something I think about this topic isn't correct?" (Baer & Garrett, 2010; Spires & Donley, 1998; H. Thompson & Carr, 1995).

ENCOURAGING A MEANINGFUL LEARNING SET AND CONCEPTUAL UNDERSTANDING

We can't always blame students when they take a relatively meaning*less* approach to their studies. Inadvertently, some teachers tend to encourage students to learn school subjects by rote. Think back to your own experiences in school. How many times were you allowed to define a word by repeating its dictionary definition, rather than being expected to explain it in your own words? In fact, how many times were you *required* to learn something word for word? And how

many times did an exam assess your knowledge of facts or principles without ever assessing your ability to relate those facts and principles to everyday life or to things you learned in previous lessons or courses? When assignments and assessments require memory of isolated facts—and perhaps even require word-for-word recall—students are apt to engage in rote rather than meaningful learning, believing that a rote-learning approach will yield them better grades (Crooks, 1988; N. Frederiksen, 1984b; M. C. Linn & Eylon, 2011; L. Shepard, Hammerness, Darling-Hammond, & Rust, 2005).

As teachers, we should not only encourage meaningful learning through the strategies previously described—asking students to logically organize the things they're studying, think of new examples, speculate about implications, and the like—but we should also communicate that school topics are to be *understood* rather than memorized. In other words, we should encourage students to adopt a meaningful learning set. For example, we might frequently ask students to explain their reasoning, and our assignments and assessment tasks should require true understanding rather than rote memorization (Ausubel, Novak, & Hanesian, 1978; Middleton & Midgley, 2002; L. Shepard et al., 2005).

Ideally, students should gain a conceptual understanding of classroom topics; that is, they should form many logical connections among related concepts and principles. For example, rather than simply memorize basic mathematical computation procedures, students should learn how those procedures reflect underlying principles of mathematics. And rather than learn historical facts as lists of unrelated people, places, and dates, students should place those facts within the context of major social and religious trends, migration patterns, economic conditions, human personality characteristics, and other relevant phenomena. The more interrelationships students form within the subject matter they're learning—in other words, the better they *organize* it—the more easily they'll be able to remember and apply it later on (Baroody et al., 2013; M. C. Linn & Eylon, 2011; J. J. White & Rumsey, 1994).

Constructing an integrated understanding of any complex topic inevitably takes time. Accordingly, many experts advocate the principle *Less is more: Less* material studied thoroughly (rather than superficially) is learned *more* completely and with greater understanding (e.g., Brophy et al., 2009; M. C. Linn, 2008; Sizer, 2004). Following are several more specific strategies for promoting conceptual understanding of classroom subject matter:

- Organize units around a few core ideas or themes, always relating specific content back to this core.
- Explore each topic in depth—for example, by considering many examples, examining cause–and–effect relationships, and discovering how specific details relate to more general principles.
- Regularly connect new ideas to students' personal experiences and to things students have previously learned at school.
- Emphasize that conceptual understanding is far more important than knowledge of specific facts—not only through the statements you make but also through the questions you ask, the assignments you give, and the criteria you use to evaluate achievement.
- Ask students to teach what they've learned to others. Teaching others encourages them to focus on and pull together main ideas in ways that make sense. (Brophy, 2004; Brophy et al., 2009; Hatano & Inagaki, 1993; Middleton & Midgley, 2002; Perkins & Ritchhart, 2004; Roscoe & Chi, 2007; VanSledright & Brophy, 1992; J. J. White & Rumsey, 1994)

USING MNEMONICS IN THE ABSENCE OF RELEVANT PRIOR KNOWLEDGE

Some things are hard to make sense of—that is, hard to learn meaningfully. For instance, why do bones in the human body have such names as *fibula, humerus,* and *ulna?* Why is *Au* the chemical symbol for gold? Why is Augusta the capital of the state of Maine? From most students' perspectives, there's no rhyme or reason to such facts.

When students have trouble finding relationships between new material and their prior knowledge, or when a body of information seemingly has no organizational structure (as is true for many lists), special memory tricks known as mnemonics can help students remember classroom material more effectively. Three commonly used mnemonics—verbal mediation, the keyword method, and superimposed meaningful structures—are described in Figure 6.8.

Research consistently supports the effectiveness of using mnemonics in learning (e.g., R. K. Atkinson et al., 1999; M. S. Jones, Levin, Levin, & Beitzel, 2000; Pressley, Levin, & Delaney, 1982; Soemer & Schwan, 2012). Their effectiveness lies in their conformity with a basic principle of long-term memory storage: Learners find some sort of meaning—even if that "meaning" is a bit contrived—in what might otherwise be nonsensical information. The artificial organization structure that some mnemonics provide is an additional plus. Imposing rhythm on a body of information—for instance, embedding the information in a song or hip-hop lyrics—is one way of giving it structure and can be especially beneficial when music is a significant part of students' cultures (B. A. Allen & Boykin, 1991; Barton, Tan, & Rivet, 2008; Tyler, Uqdah, et al., 2008).

When Knowledge Construction Goes Awry: Addressing Learners' Misconceptions

When learners construct their own understandings, there's no guarantee that they'll construct accurate ones. Occasionally they may instead construct misconceptions—beliefs that are inconsistent with commonly accepted and well-validated explanations of phenomena or events. For example, in science, some of students' beliefs might be at odds with data collected over the course of decades or centuries of scientific research. And in history, students' understandings of certain events might be inconsistent with existing historical records and artifacts from the time period in question. Figure 6.9 presents misconceptions that researchers have often observed in students—not only in children and adolescents, but occasionally in college students as well.

In many instances students' misconceptions arise out of their own well-intended efforts to make sense of the things they see—for example, a sun and moon that seem to "travel" across the sky. But society and culture can foster misconceptions as well. Sometimes common expressions in language misrepresent the true nature of physical events. For instance, when we talk about the sun "rising" and "setting," children might easily conclude that the sun revolves around the earth, rather than vice versa. Sometimes people infer incorrect cause-and-effect relationships between two events simply because the events often occur at the same time—a problem of mistaking correlation for causation. In addition, fairy tales and cartoons may misrepresent what we know to be true in, say, physics or paleontology—as examples, you've probably watched cartoon bad guys run off cliffs and remain suspended in the air until they realize there's nothing holding them up, and perhaps you've seen cartoon cavemen riding on dinosaurs. And unfortunately, it's sometimes the case that students acquire erroneous ideas from textbooks, teachers, the Internet, or the general social and cultural group in which they live (A. C. Butler, Zaromb, Lyle, & Roediger, 2009; Cho, 2010; Glynn, Yeany, & Britton, 1991; Levstik, 2011; M. C. Linn & Eylon, 2011; Marcus, 2008; Wiser & Smith, 2008).

Regardless of how students' misconceptions originate, they can wreak havoc on new learning. As a result of elaborating on new information—a process that usually facilitates learning—students may interpret or distort the information to be consistent with what they already "know" and thus continue to believe what they've always believed. For example, one 11th-grade physics class was studying the idea that an object's mass and weight do *not*, by themselves, affect the speed at which the object falls. Students were asked to build egg containers that would keep eggs from breaking when dropped from a third-floor window. They were told that on the day of the egg drop, they would record the time it took for the eggs to reach the ground. Convinced that heavier objects fall faster, a student named Barry added several nails to his egg's container. Yet when he dropped it, classmates timed its fall at 1.49 seconds—a time very similar to that for other students' lighter containers. Rather than acknowledge that light and heavy objects fall at the same rate, Barry explained the result by rationalizing that "the people weren't timing real good" (Hynd, 1998a, p. 34).

When students have misunderstandings such as Barry's, we must work hard to promote conceptual change, a process of revising or overhauling an existing theory or belief system in such a way that new, discrepant information can be better understood and explained. Don't let the term *conceptual* mislead you here: For the most part, we're talking about changing tightly interconnected sets of ideas rather than changing single, isolated concepts.

OBSTACLES TO CONCEPTUAL CHANGE

Teachers often present new information with the expectation that it will easily replace students' erroneous beliefs about a topic. And in fact some misconceptions are easily corrected. Yet students of all ages can hold quite stubbornly to certain counterproductive beliefs about the world, even after considerable instruction that explicitly contradicts those beliefs. Theorists have offered several possible explanations about why students' misconceptions can be so resistant to change.

- *Students' existing beliefs affect their interpretations of new information.* Thanks to the processes of meaningful learning and elaboration—processes that usually facilitate learning—learners are more likely to interpret new information in ways that are consistent with what they already "know" about the world. For example, after one 4-year-old dinosaur enthusiast read a book about how increasingly cold temperatures may have contributed to the dinosaurs' extinction, he speculated that "they did not know how to put on their sweaters" (M. C. Linn & Eylon, 2011, p. 1). Presumably, he eventually rejected his "sweater" hypothesis, but in many cases people continue to believe some or all of what they've always believed despite convincing evidence to the contrary (Andiliou, Ramsay, Murphy, & Fast, 2012; Brewer, 2008; Kalyuga, 2010; Kendeou & van den Broek, 2005).

  Furthermore, people of all ages (even college students!) tend to actively *look* for information that confirms their existing beliefs and to ignore or discredit contradictory evidence—a phenomenon known as **confirmation bias** (Chinn & Buckland, 2012; Hynd, 1998b; P. K. Murphy & Mason, 2006). For example, when students in a high school science lab observe results that contradict what they expected to happen, they might complain, "Our equipment isn't working right," or "I can never do science right anyway" (Minstrell & Stimpson, 1996, p. 192).
- *Students' existing beliefs may be more consistent with their everyday experiences.* Well-established scientific theories are often fairly abstract and sometimes seem to contradict everyday reality (D. B. Clark, 2006; M. C. Linn, 2008; Wiser & Smith, 2008). For example, in physics, although the law of inertia tells us that force is needed to *start* an object in motion but not to *keep* it in motion, we know from experience that if we want to move a heavy object across the floor, we must continue to push it until we get it where we want it (Driver, Asoko, Leach, Mortimer, & Scott, 1994). And although virtually any piece of matter has some weight, a very small piece of Styrofoam may feel weightless in our hands (C. L. Smith, 2007).

- *Some beliefs are integrated into a cohesive whole, with many interconnections among ideas.* In such circumstances, changing misconceptions involves changing a tightly organized set of understandings—perhaps a personally constructed theory or perhaps an entire *worldview*—rather than a single belief (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; J. L. McClelland, 2013; P. K. Murphy & Mason, 2006; Rosengren, Brem, Evans, & Sinatra, 2012). For example, the belief that the sun revolves around the earth may be part of a more general earth-centered view of things, perhaps one that includes the moon, stars, and other heavenly bodies revolving around the earth as well. In reality, of course, the moon revolves around the earth, the earth revolves around the sun, and other stars aren't directly involved with the earth in one way or another. Yet the earth-centered view is a much easier one to understand and accept—on the surface, at least—and everything seems to fit so nicely together.
- *Students may fail to notice an inconsistency between new information and their existing beliefs.* Sometimes this happens because students learn the new information in a rote manner, without relating it to things they already know and believe. In other instances it occurs because existing misconceptions take the form of *implicit knowledge*—knowledge that students aren't consciously aware of. In either circumstance, students don't realize that the material they're studying contradicts their current understandings, and thus they may continue to apply their misconceptions when interpreting new situations (Fernbach, Rogers, Fox, & Sloman, 2013; P. K. Murphy, 2007; Sinatra, Kienhues, & Hofer, 2014; Strike & Posner, 1992).
- *Students may have a personal or emotional investment in their existing beliefs.* For one reason or another, students may be especially committed to certain beliefs, perhaps insisting "This theory is what I believe in! Nobody can make me change it!" (Mason, 2003, p. 228). In some instances their beliefs may be an integral part of their religion or culture. In other cases students may interpret information that contradicts their existing understandings as a threat to their self-esteem. In either situation, students may cling to their current understandings even more tightly than they had before encountering more valid and productive explanations (Lewandowsky et al., 2012; Linnenbrink & Pintrich, 2003; Porat, 2004; Rosengren et al., 2012; Sherman & Cohen, 2002).

Long-Term Memory Retrieval

As you've already discovered, some of the information stored in long-term memory is easily retrieved later on. Other pieces of information are harder to find, and still others may never be found at all. Retrieving information from long-term memory appears to involve following a

pathway of associations; it's a process of mentally going down Memory Lane. One idea reminds us of another idea—that is, one idea *activates* another—the second idea reminds us of a third idea, and so on. The process is similar to what happened when you followed your train of thought from the word *horse* earlier in the chapter. If the pathway of associations eventually leads us to what we're trying to remember, we do indeed remember it. If the path takes us in another direction, we're out of luck.

Learners are more likely to remember something later on if, in the process of storing it, they connect it with something else in long-term memory. Ideally, the new and the old have a logical relationship. To illustrate this idea, let's return once again to all that mail you routinely get in your mail and email boxes. Imagine that, on average, you receive five important items—five things you really want to save—each day. That adds up to more than 1,800 items a year. Over the course of 15 years, you would have more than 27,000 important things stashed somewhere in your home, on your computer, or in a back-up storage mechanism.

Imagine that one day you hear that stock in a clothing company (Mod Bod Jeans) has tripled in value. You remember that your wealthy Aunt Agnes bought you some Mod Bod stock for your birthday several years ago, and you presumably decided that the paperwork documenting her purchase was important enough to save. But where in the world did you put it? How easily you find it—in fact, whether you find it at all—depends on how you've been storing your mail as you've accumulated it. If you've been storing it in a logical, organized fashion—for instance, maybe you've put all the bills you've paid by regular mail on a closet shelf, all banking and investment paperwork in alphabetical order in a file drawer, and all electronic documents from family and friends in labeled folders on your computer—you should quickly find Aunt Agnes's gift. But if you simply tossed each day's mail and email messages randomly about, you'll be searching for a long, long time, possibly without ever finding a trace of the Mod Bod stock.

Like a home with 15 years' worth of mail, long-term memory contains a great deal of information. And like your search for the Mod Bod purchase, the ease with which information is retrieved from long-term memory depends somewhat on whether the information has been stored in a logical place—that is, whether it's connected to related ideas. By making connections to existing knowledge—that is, by engaging in meaningful learning—we'll know where to look for information when we need it. Otherwise, we may never retrieve it again.

FACTORS AFFECTING RETRIEVAL

Even when people connect new information to their existing knowledge base, they can't always find it when they need it. We now look at several factors affecting retrieval from long-term memory.

MULTIPLE CONNECTIONS WITH EXISTING KNOWLEDGE AND A VARIETY OF CONTEXTS

Sometimes learners acquire and practice certain behaviors and ways of thinking in a very limited set of environments—say, in their science or civics classes. When this happens, the learners may associate those behaviors and ways of thinking *only* with those particular environments and thus fail to retrieve what they've learned when they're in other contexts (Day & Goldstone, 2012; Greeno, Collins, & Resnick, 1996; Gresalfi & Lester, 2009; Kirsh, 2009). This tendency for some responses and cognitive processes to be associated with and retrieved in some contexts but not others is often called **situated learning** or **situated cognition**. For example, if students associate principles of geometry only with math classes, they may not retrieve those principles at times when geometry would come in handy—say, when trying to determine whether a 10-inch pizza that costs $8.00 is a better value than an 8-inch pizza that costs $6.00.

In general, learners are more likely to retrieve information when they have *many* possible pathways to it—in other words, when they have associated the information with many other things they know and with many different contexts in which they might use it. Making multiple connections is like using cross-references in your mail storage system. You may have filed the Mod Bod paperwork in your banking/investments file drawer, but you may also have written its location on notes-to-self you've put in other places—perhaps with your birth certificate (after all, you received the stock on your birthday) and in a computer folder of family documents and photos

(because a family member gave you the stock). By looking in one of these logical places, you'll discover where to find the Mod Bod documentation.

As teachers, we can help students more effectively remember classroom subject matter over the long run if we show how it relates to *many* other things they already know. For example, we can show them how new material relates to one or more of the following:

- Concepts and ideas within the same subject area (e.g., showing how multiplication is related to addition)
- Concepts and ideas in other subject areas (e.g., talking about how scientific discoveries have affected historical events)
- Students' general knowledge of the world (e.g., relating the concept of *inertia* to how passengers are affected when a car quickly turns a sharp corner)
- Students' personal experiences (e.g., finding similarities between the family feud in *Romeo and Juliet* and students' own interpersonal conflicts)
- Students' current activities and needs outside the classroom (e.g., showing how persuasive writing skills might be used to craft an essay for a college application)

DISTINCTIVENESS

Learners are more likely to remember things that are unique in some way—for instance, things that are new, unusual, or a bit bizarre (R. R. Hunt & Worthen, 2006). For example, second graders are more likely to remember a visit to the local firehouse than, say, their teacher's explanation of what an *adverb* is. And when U.S. high school students recall what they've learned about events leading up to the American Revolution, they're more likely to remember the Boston Tea Party—a unique and colorful illustration of colonists' dissatisfaction with British taxation policies—than, say, the Quartering Act or the publication of Thomas Paine's *Common Sense.* Certainly, learners are more likely to *pay attention* to distinctive information, increasing the odds that they store it in long-term memory in the first place. But even when attention and initial learning have been the same, distinctive information is easier to retrieve than dull-and-ordinary information (Craik, 2006; Mather & Sutherland, 2011).

EMOTIONAL OVERTONES

As learners pay attention to and think about new information, their thoughts and memories sometimes become emotionally charged—a phenomenon called **hot cognition**. For example, learners might get excited when they read about advances in science that could lead to effective treatments for cancer, spinal cord injuries, or mental illness. Or they might feel sadness and empathy when they read about poor living conditions in certain parts of the world. And they will, we hope, get angry when they learn about atrocities committed against African American slaves in the pre–Civil War days of the United States or about large-scale genocides carried out in more recent times in Europe, Africa, and Asia.

When information is emotionally charged in such ways, learners are more likely to pay attention to it, continue to think about it for an extended period, and repeatedly elaborate on it (Bower, 1994; Heuer & Reisberg, 1992; M. I. Posner & Rothbart, 2007; Zeelenberg, Wagenmakers, & Rotteveel, 2006). And over the long run, learners can usually retrieve material with high emotional content more easily than they can recall relatively nonemotional information (LaBar & Phelps, 1998; Phelps & Sharot, 2008; Reisberg & Heuer, 1992).[1] It appears that students' emotional reactions to classroom topics become integral parts of their network of associations in long-term memory (Bower & Forgas, 2001; Siegel, 2012).

Academic subject matter certainly doesn't need to be dry and emotionless. In addition to presenting subject matter that evokes students' emotions, we can promote hot cognition by revealing our own feelings about a topic. For instance, we might bring in newspaper articles and other outside materials about which we're excited, or we might share the particular questions and issues about which we ourselves are concerned (Brophy, 2004; R. P. Perry, 1985).

REGULAR PRACTICE

As noted earlier, rehearsal—mindlessly repeating information over and over within the course of a few seconds or minutes—is a relatively *in*effective way of getting information into long-term memory. But by "regular practice" here, we mean repetition over a *lengthy* time span: reviewing and using information and skills at periodic intervals over the course of a few weeks, months, or years. When practice is spread out in this manner—ideally in a variety of contexts—people of all ages learn something better and remember it longer (Karpicke, 2012; Lindsey, Shroyer, Pashler, & Mozer, 2014; Rohrer & Pashler, 2010).

When learners continue to practice things they've already mastered, they eventually achieve automaticity: They can retrieve what they've learned quickly and effortlessly and can use it almost without thinking (J. R. Anderson, 2005; Pashler, Rohrer, Cepeda, & Carpenter, 2007; Proctor & Dutta, 1995). As an example, think of driving a car, a complicated skill that you can probably perform easily. Your first attempts at driving many years ago may have required a great deal of mental effort. But perhaps now you can drive without having to pay much attention to what you're doing. Even if your car has a standard transmission that frequently requires stepping on a clutch and shifting gears, driving is, for you, an automatic activity.

Learning some knowledge and skills to a level of automaticity has a second advantage as well. Remember that working memory has a limited capacity: The active, consciously thinking part of the human memory system can handle only so much at a time. When much of its capacity must be used for recalling isolated facts or carrying out simple procedures, little room is left for addressing more complex situations or tasks. One key reason for learning some facts and procedures to the point of automaticity, then, is to free up working memory capacity for complex tasks and problems that require those simpler facts and procedures (De La Paz & McCutchen, 2011; L. S. Fuchs et al., 2013; Kalyuga, 2010; Limpo & Alves, 2013). For example, second graders who are reading a story can better focus their efforts on understanding it if they don't have to sound out words like *before* and *after*. High school chemistry students can more easily interpret the expression Na_2CO_3 (sodium carbonate) if they don't have to stop to think about what the symbols *Na*, *C*, and *O* represent.

Unfortunately, automaticity is achieved in only one way: practice, practice, and more practice. Practice doesn't necessarily make perfect, but it does make knowledge more durable and more easily retrievable. When learners use information and skills frequently, they essentially pave their retrieval pathways—in some cases creating superhighways. This is *not* to say that we should continually assign drill-and-practice exercises involving isolated facts and procedures (e.g., see Figure 6.11). Such activities promote rote (rather than meaningful) learning, are often boring, and are unlikely to convince students of the value of the subject matter (Mac Iver, Reuman, & Main, 1995). A more effective approach is to routinely incorporate basic knowledge and skills into a variety of meaningful and enjoyable activities, such as problem-solving tasks, brainteasers, group projects, and games.

RELEVANT RETRIEVAL CUES

If you were educated in North America, then at one time or another you probably learned the names of the five Great Lakes. Yet at any given moment you might have trouble retrieving all five, even though they're all still stored somewhere in your long-term memory. Perhaps Lake Michigan doesn't come to mind when you retrieve the other four. The *HOMES* mnemonic presented in Figure 6.8 provides a retrieval cue—a hint about where to "look" in long-term memory. The mnemonic tells you that one lake begins with the letter *M,* prompting you to search among the *M* words you know until (we hope) you find *Michigan.* Learners are more likely to retrieve information when relevant retrieval cues are present to start their search of long-term memory in the right direction (e.g., Morris, Bransford, & Franks, 1977; Tulving & Thomson, 1973).

Providing retrieval cues is often useful in the classroom, especially when students have trouble recalling information that might help them remember or apply *other* information. For example, if a student asks what the symbol *Au* stands for, we might respond by saying "One day we talked about how *Au* comes from the Latin word *aurum.* Can you remember what *aurum* means?" Another example comes from Jess Jensen, a former teacher intern of one of us authors. A student in her eighth-grade history class had been writing about the Battle of New Orleans, which was a decisive victory for the United States in the War of 1812. The following exchange took place:

> ***Student:*** Why was the Battle of New Orleans important?
>
> ***Jess:*** Look at the map. Where is New Orleans?
>
> [The student finds New Orleans.]
>
> ***Jess:*** Why is it important?
>
> ***Student:*** Oh! It's near the mouth of the Mississippi. It was important for controlling transportation up and down the river.

In the early grades, teachers typically provide many retrieval cues for their students; for instance, they remind students about tasks they need to do at certain times ("I hear the fire alarm. Remember, we must all walk quietly during a fire drill"). But as students grow older, they must develop greater independence, relying more on themselves and less on their teachers for the things they need to remember. At all grade levels we can teach students ways of providing retrieval cues for *themselves.* For example, if we expect first graders to get a permission slip signed, we might ask them to write a reminder on a piece of masking tape that they put on their jacket or backpack. If we give junior high school students a major assignment due in several weeks, we might suggest that they tape a note with the due date to their bedside table or add one or more reminders to their cell phone calendar. One 10th grader developed several effective retrieval cues, each appropriate for certain situations:

Homework is written down in my agenda book. If it is something to do when I get home, I will write it on my hand. If I have something to do in the next few days, I write it on a note card in my wallet, and whenever I go to get money, I will think to do it.

WAIT TIME

Wait time is the length of time a teacher allows to pass after the teacher or a student says something before the teacher says something else. In many classrooms, wait time is insufficient for most students to retrieve information that might be relevant to a teacher's or classmate's question or comment. For instance, when teachers ask one or more students a question, many wait for only a very short time—perhaps a second or less—and if they don't get a response, they ask someone else the same question, rephrase the question, or answer the question themselves. Many teachers are equally reluctant to let more than a second elapse after students answer questions or make comments in class; they're apt to jump in very quickly to respond to a student comment or ask another question (Jegede & Olajide, 1995; M. B. Rowe, 1974, 1987).

Students benefit tremendously simply from being given a little time to think. When teachers instead allow at least *3 seconds* of wait time, more students participate in class—this is especially true for females and minority-group members—and students begin to respond to one another's comments and questions. In addition, students are more likely to support their reasoning with evidence or logic and more likely to speculate when they don't know an answer. Furthermore, they're more motivated to learn classroom subject matter, thereby increasing actual learning and decreasing behavior problems. Such changes are due, in part, to the fact that with increased wait time, *teachers'* behaviors change as well. Teachers ask fewer simple questions (e.g., those requiring recall of facts) and more thought-provoking ones (e.g., those requiring elaboration). They also modify the direction of discussion to accommodate students' comments and questions, and they allow their classes to pursue a topic in greater depth than they had originally anticipated. Moreover, their expectations for many students, especially low-achieving ones,

begin to improve (Castagno & Brayboy, 2008; Giaconia, 1988; M. B. Rowe, 1974, 1987; Tharp, 1989; Tobin, 1987).

When our objective is simple recall—when students need to retrieve classroom material very quickly, to "know it cold"—then wait time should be short. Students may sometimes benefit from rapid-fire drill and practice to learn information and skills to automaticity. But when our instructional goals include more complex processing of ideas and issues, a longer wait time may give both our students and us the time everyone needs to think things through.

WHY LEARNERS SOMETIMES FORGET

Fortunately, people don't need to remember everything they've stored. For instance, you may have no reason to remember the Internet address of a website you looked at yesterday, the plot of last week's episode of a certain television show, or the due date of an assignment you turned in last semester. Much of the information learners encounter is, like junk mail, not worth keeping, and forgetting it enables learners to get rid of needless clutter. But sometimes learners have trouble recalling what they *do* need to remember. Here we look at several possible explanations for why students may sometimes forget important information.

FAILURE TO STORE OR CONSOLIDATE INFORMATION IN LONG-TERM MEMORY

As we've seen, a great deal of the information students encounter never reaches long-term memory. Perhaps students didn't pay attention in the first place, so the information never went beyond the sensory register. Or perhaps after attending to it, students didn't continue to process it, so it went no further than working memory.

Even when information does reach long-term memory, it needs some time to "firm up" in the brain—a process called consolidation (Rasch & Born, 2008; Wixted, 2005). A good night's sleep after learning something new seems to facilitate this process (see the earlier Applying Brain Research feature). And an event that interferes with consolidation—such as a serious brain injury—may cause someone to forget things that happened several seconds, minutes, hours, or even longer prior to the event (Bauer, DeBoer, & Lukowski, 2007; Wixted, 2005).

DECAY

Historically, many psychologists believed that once information is stored in long-term memory, it remains there permanently in some form (Loftus & Loftus, 1980). More recently, however, some psychologists have come to the conclusion that information can slowly weaken and eventually disappear—that is, it can decay—especially if it isn't used regularly (e.g., Altmann & Gray, 2002; Brainerd & Reyna, 2005; Schacter, 1999).

INSUFFICIENT SEARCH OF LONG-TERM MEMORY

A man at the supermarket looks familiar, but you can't remember who he is or where you met him. He smiles at you and says, "Nice to see you again." Gulp! You desperately search your long-term memory for his name, but you've clearly forgotten who he is. A few days later you have a bowl of chili for dinner. The chili reminds you of the Chili for Charity supper at which you worked a few months back. Of course! You and the man at the supermarket had stood side by side serving chili to hundreds of people that night. Oh yes, you now recall, his name is Melville Herman.

Like you, students often have retrieval difficulties: They simply can't find something that's actually in long-term memory (e.g., Schacter, 1999). Sometimes they may stumble on the information later, while looking for something else. But at other times they never do retrieve it, perhaps because they've learned it by rote or don't have sufficient retrieval cues to guide their memory search.

INTERFERENCE

Sometimes people can easily retrieve things they've learned but don't know what goes with what. To experience this phenomenon yourself, try the following exercise.

EXPERIENCING FIRSTHAND
SIX CHINESE WORDS

Following are six more Mandarin Chinese words and their English meanings (for simplicity's sake, we've omitted the tone marks over the words). Read the words two or three times, and try to store them in your long-term memory. But don't do anything special to learn the words—for instance, don't intentionally develop mnemonics to help you remember them.

Chinese	English
jung	middle
ting	listen
sung	deliver
peng	friend
ching	please
deng	wait

Now cover up the list of words and test yourself. What is the Chinese word for *friend?* For *please?* For *listen?* For *wait?*

Did you find yourself getting confused, perhaps forgetting which English meaning went with each Chinese word? If you did, you were the victim of interference. The various pieces of information you stored in memory were interfering with one another—essentially, they were getting mixed up in your head. Interference is especially likely to occur when items are similar to one another and when they're learned in a rote rather than meaningful or mnemonic-based fashion (Dempster, 1985; Healey, Campbell, Hasher, & Ossher, 2010; Lustig, Konkel, & Jacoby, 2004). Interference was probably at work when Kanesha struggled to remember *tibia* and *fibula*—two similar-sounding bones in the lower leg—in the opening case study.

RECONSTRUCTION ERROR

Have you and a friend ever remembered the same event quite differently, even though the two of you were equally active participants at the time? Were you and your friend both certain of the accuracy of your own memories and convinced that the other person remembered incorrectly? Constructive processes in retrieval might explain this difference of opinion. Retrieval isn't necessarily an all-or-nothing phenomenon. Sometimes learners retrieve part of the information they're seeking but can't recall the rest. They may logically but incorrectly fill in the gaps using their general knowledge and assumptions about the world. This form of forgetting—which might be better labeled as *misremembering*—is called reconstruction error (Levstik, 2011; Roediger & McDermott, 2000; Schacter, 1999).

Recalling an event we've previously experienced often affects our later memory for the event, especially if we verbally describe the event and perhaps embellish on it in some way (Karpicke, 2012; E. J. Marsh, 2007; Seligman, Railton, Baumeister, & Sripada, 2013). Neurologically speaking, by recalling the event, we're also revising and *reconsolidating* it in the brain—that is, we're firming it up anew—with a mixture of information we actually received and our elaborations of it (Finn & Roediger, 2011; Schacter, 2012; Schiller et al., 2010).

All of these explanations of forgetting underscore the importance of instructional strategies presented earlier: We must make sure students are paying attention, help them relate new material to things they already know, and give them frequent opportunities to review, practice, and apply the material.

Diversity in Cognitive Processes

Children and adolescents differ considerably in the various factors that influence their ability to learn and remember in the classroom, including their attention spans, working memory capabilities, long-term memory storage processes, and prior knowledge. For example, on average, girls have a slight edge over boys in keeping their attention focused on classroom activities and in performing certain kinds of memory tasks, such as remembering lists and specific life events (Das, Naglieri, & Kirby, 1994; Halpern, 2006; Halpern & LaMay, 2000). And students of both genders vary in their general ability to think about, encode, and respond to new events and ideas quickly and easily. Some of this variability is the result of differences in working memory capacity and executive functioning. Students with a smaller overall capacity and minimal ability to mentally control what they're thinking about often have trouble remembering instructions, tackling complex tasks, and keeping their minds on a task at hand—all of which adversely affect their academic achievement levels (Alloway, Gathercole, Kirkwood, & Elliott, 2009; DeMarie & López, 2014; Miyake & Friedman, 2012). Working memory and executive functioning difficulties are especially common in children who have grown up in chronically stressful living conditions, often as a result of living in extreme poverty (G. W. Evans & Schamberg, 2009; Masten et al., 2012; Noble, McCandliss, & Farah, 2007).

Another important source of diversity in cognitive processing is cultural background. Different cultures foster somewhat different ways of looking at physical and social events—different worldviews—that influence how students interpret classroom subject matter. For example, students whose cultures have taught them to strive to live in harmony with their natural environment may struggle with a science curriculum that urges them to *change* their environment in some way (Atran, Medin, & Ross, 2005; Medin, 2005). And whereas students of European ancestry are apt to view the Europeans' migration to North America in the 1600s and 1700s as a process of *settlement,* students with Native American backgrounds might instead view it as increasing *invasion* (Banks, 1991; VanSledright & Brophy, 1992).

Children's varying cultural backgrounds may also have prepared them to handle different kinds of learning environments and tasks. For instance, African American and Hispanic students are more likely than European American students to be comfortable in environments in which several activities are going on at once and can more easily shift their attention from one activity to another (Correa-Chávez, Rogoff, & Mejía Arauz, 2005; Tyler, Uqdah, et al., 2008). Students from North American, East Asian, and Middle Eastern cultures are apt to have had experience rote-memorizing specific facts and written materials (perhaps in the form of multiplication tables, poems, or religious teachings), whereas students from certain cultures in Africa, Australia, and Central America may have been encouraged to remember oral histories or particular landmarks in the local terrain (L. Chang et al., 2011; Rogoff, 2001, 2003; Rogoff et al., 2007; Q. Wang & Ross, 2007).

The importance of wait time depends partly on students' cultural backgrounds as well. For example, some Native American students may wait several seconds before responding to a question as a way of showing respect for an adult (Castagno & Brayboy, 2008; Gilliland, 1988). And English language learners—students who have grown up in a non-English-speaking environment and are still developing their proficiency in English—are apt to require more mental translation time than their native-English-speaking peers (Igoa, 2007).

To maximize each student's learning and achievement in the classroom, we must take such individual and group differences into account. For example, we should be especially careful to engage the interest of—and also minimize distractions for—those students whose attention easily wanders. In addition, in our attempts to promote meaningful learning and other effective storage processes, we should relate classroom subject matter to the diverse background experiences that students have had. And we must allow sufficient wait time after questions and comments so that all students can actively think about and elaborate on topics of discussion.

FACILITATING COGNITIVE PROCESSING IN STUDENTS WITH SPECIAL NEEDS

Some diversity in learning and cognitive processes is the result of certain disabilities, on the one hand, or giftedness, on the other. For example, some students with disabilities have particular trouble attending to and effectively processing classroom subject matter. This is certainly true for

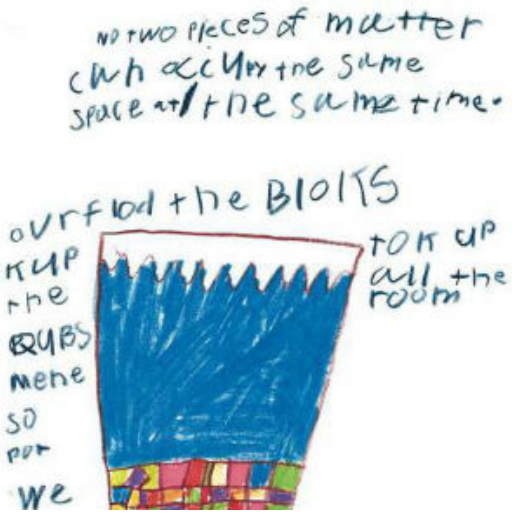
Chapter 5 identifies specific categories of special needs that fall within the five general categories listed in Table 6.5.

students with learning disabilities (who, by definition, have deficits in specific cognitive processes), and it's often true for students with attention-deficit hyperactivity disorder (ADHD) and general intellectual disabilities as well. In contrast, many children with autism spectrum disorders can be *very* attentive, sometimes to the point that they have trouble shifting to new tasks. And on average, gifted students have a longer attention span and can process new ideas more rapidly and elaboratively than many of their classmates. Table 6.5 identifies commonly observed cognitive processing differences in students who have special educational needs.

As teachers, we must keep in mind that students with disabilities almost invariably have strengths as well as weaknesses. For example, some students with ADHD have a keen memory for events they've personally experienced and may generate more detailed narratives than their nondisabled classmates (Skowronek, Leichtman, & Pillemer, 2008). And some students with autism spectrum disorders notice and remember many subtle nuances in the things they see and may produce highly detailed and skillful drawings that are unusual for their age-group (I. L. Cohen, 2007; S. Moran & Gardner, 2006).

The far-right column of Table 6.5 presents many useful strategies for working with students who have special educational needs. The first of these—analyzing students' errors for clues about possible processing difficulties—is illustrated in 9-year-old Nicholas's lab report in Figure 6.12. Nick's description of what he observed can be translated as "We poured so many cubes [that] the cup overflowed. The blocks took up all the room." We can only speculate about why Nick wrote up the left side of the glass, across the top, and then down the other side. One possible explanation is that, with his limited language skills, Nick hadn't yet mastered the conventional direction of written English. This hypothesis seems unlikely, however, as other samples of Nick's writing (not shown here) correctly begin at the top of the page and proceed downward. Another possibility is that Nick was thinking about the direction of the water flow (up and out) as he wrote and either intentionally or unintentionally followed the water's direction in his writing. His limited working memory capacity may have been a factor here: Perhaps he had insufficient mental "room" to think simultaneously about his observations plus the spellings of words and conventions of written English.

FIGURE 6.12 In a science activity in his third-grade class, 9-year-old Nicholas copied the scientific principle "No two pieces of matter can occupy the same space at the same time" onto a sheet of paper. He and a lab partner then filled a cup with water and dropped, one at a time, more than a dozen small metal cubes into the cup. Here Nick recorded his observations with both words and a drawing.



Islamic Online University
Lecture Notes for Modules 13 & 14

TEXTBOOK CHAPTER 7: COMPLEX COGNITIVE PROCESSES

LEARNING OUTCOMES

1 Explain how learners' metacognitive knowledge and skills influence their learning and academic achievement; also explain how you can promote metacognitive development in your own students.
2 Describe various forms that transfer might take and the conditions in which transfer is most likely to occur, and apply research findings about transfer to your classroom practices.
3 Describe four general factors that influence problem-solving performance; also describe teaching strategies you can use to help students successfully solve both well-defined and ill-defined problems.
4 Identify several instructional strategies that can encourage students to think creatively as they tackle new tasks and problems.
5 Describe several different forms that critical thinking can take, and explain how you can help students critically evaluate what they see, hear, and read both inside and outside the classroom.
6 Give examples of the diversity you might see in creativity, critical thinking, and other complex thinking processes as a result of students' cultural backgrounds, disabilities, or advanced cognitive development.

Metacognition and Learning Strategies

The term **metacognition** literally means "thinking about thinking." It encompasses knowledge and beliefs about the general nature of human cognitive processes, reflection on one's *own* cognitive processes, and intentional engagement in behaviors and thought processes that enhance learning and memory. For example, you've undoubtedly learned by now that you can acquire only so much information so fast—you can't possibly absorb the contents of an entire textbook in an hour. You've also discovered that you can learn information more quickly and recall it more easily if you put it into some sort of organizational framework. Perhaps, too, you've learned that you need to periodically check yourself to make sure you remember and understand what you've read.

The more learners know about thinking and learning—that is, the greater their *metacognitive awareness*—the better their learning and achievement is likely to be (Eason, Goldberg, Young, Geist, & Cutting, 2012; B. Hofer & Pintrich, 2002; Schneider, 2010). Furthermore, students who have a more advanced understanding of learning and thinking—for instance, students who realize that one's knowledge of a topic continues to evolve over time—are more likely to undergo conceptual change when it's warranted (Mason, 2010; Sinatra & Pintrich, 2003).

As children grow older, they become increasingly aware of their own thinking and learning processes and increasingly realistic about what they can learn and remember in a given time period (see Table 7.1). With this growing self-awareness come more sophisticated study strategies. Truly effective strategies emerge quite slowly, however, especially if young learners don't get guidance from teachers, parents, or other adults about how to study and learn (J. E. Barnett, 2001; Schommer, 1994a; Schneider, 2010; Veenman, 2011).

EFFECTIVE LEARNING STRATEGIES

An important component of metacognition is *controlling* one's own thinking and learning to some degree. Thanks, in part, to maturational changes in the brain, children and adolescents gradually become more capable of controlling and directing their cognitive processes in their efforts to learn something new (Chein & Schneider, 2012; Eigsti et al., 2006; Kuhn & Franklin, 2006). When learners *intentionally* use a certain approach to learning and remembering something, they're using a **learning strategy**.

Information processing theorists have described several processes that may facilitate long-term memory storage, including rehearsal, elaboration, organization, and visual imagery. As children grow older, they increasingly discover the potential benefits of these processes and use them more frequently (P. A. Ornstein, Grammer, & Coffman, 2010; Pressley & Hilden, 2006). Children gradually acquire additional strategies as well. For example, consider the simple idea that you need to devote more study time to more difficult material; children don't use this seemingly obvious strategy until the fourth or fifth grade (Schneider, 2010). With age and experience, children also become more aware of which strategies are effective in different situations. Even so, many students of all ages—college students included!—seem relatively uninformed about effective learning strategies (Lovett & Flavell, 1990; Schneider, 2010; Schommer, 1994a; Short, Schatschneider, & Friebert, 1993).

Some learning strategies are overt strategies; in other words, they're behaviors we can actually see. Others, such as elaborating and forming visual images, are covert strategies; they're internal mental processes we often *can't* see (Kardash & Amlund, 1991).

OVERT STRATEGIES

Successful learning and classroom achievement are partly the result of certain behaviors, such as keeping a calendar for assignments and due dates, devoting part of every evening to schoolwork, and asking questions in times of confusion. One especially effective overt strategy is *writing* about classroom subject matter (Bangert-Drowns, Hurley, & Wilkinson, 2004; P. D. Klein, 1999; Shanahan, 2004). Here we look at research on two writing-based learning strategies: taking notes and creating summaries.

Taking notes. By the time students reach the upper elementary or middle school grades, note-taking skills begin to play a role in their classroom achievement. In general, students who take more notes learn and remember classroom subject matter better. However, the *quality* of the notes is equally important. Useful notes typically reflect the main ideas of a lesson or reading assignment (A. L. Brown, Campione, & Day, 1981; Kiewra, 1985, 1989; J. Lee & Shute, 2010). Ideally, too, students should be *making sense* of the information they're writing down—perhaps elaborating on it in some way—rather than just copying it in a rote, word-for-word manner (P. A. Mueller & Oppenheimer, 2014).

Despite the advantages of note taking, many young adolescents take few or no class notes unless specifically instructed to take them (recall the infrequent note taking in Ms. Gaunt's eighth-grade math class). And the notes they do take differ considerably in quality. For example, Figure 7.1 shows the notes that two students took about King Midas in a Greek mythology unit

in their seventh-grade language arts class. The notes on the left provide a good overall synopsis of the King Midas story and might reasonably help the student remember the story fairly accurately. In contrast, the notes on the right are probably too brief and disjointed to be useful.

Especially when students are first learning how to take notes in class, we should scaffold their efforts by giving them an idea about which things are most important to include (Meltzer, Pollica, & Barzillai, 2007; Pressley, Yokoi, van Meter, Van Etten, & Freebern, 1997). One approach is to provide a specific structure to use, such as the one shown in Figure 7.1. Another strategy, especially if students are novice note takers, is to occasionally check their notebooks for accuracy and appropriate emphasis and then to give constructive feedback.

Creating summaries. Many research studies have shown that writing a summary of material being studied can enhance students' learning and memory (A. King, 1992; R. E. Mayer, 2010b; Wade-Stein & Kintsch, 2004). Creating a good summary is a fairly complex process, however. At a minimum it includes distinguishing between important and unimportant information, synthesizing details into more general ideas, and identifying critical interrelationships. It's not surprising, then, that many middle school and high school students have trouble writing good summaries (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Hidi & Anderson, 1986).

Probably the best way of helping students acquire this strategy is to ask them frequently to summarize what they hear and read. Initially we should scaffold the process for them—for example, by providing compare/contrast tables they can fill in as they read or having them develop summaries in collaboration with peers (Spörer & Brunstein, 2009; J. P. Williams, Stafford, Lauer, Hall, & Pollini, 2009). Computer software is also available to scaffold the summarizing process (e.g., Wade-Stein & Kintsch, 2004).

COVERT STRATEGIES

Students' overt strategies—allocating some time for studying in their daily schedules, taking notes, summarizing, and so on—are probably valuable only to the extent that effective cognitive processes, or *covert strategies,* underlie them (Kardash & Amlund, 1991). For example, high-achieving students tend to benefit more from note taking than low-achieving students, perhaps

because the high-achieving students are more likely to elaborate on and organize what they're learning as they take notes (Kiewra, Benton, & Lewis, 1987; Ku, Chan, Wu, & Chen, 2008). In addition to engaging in meaningful learning processes (e.g., elaboration, organization), two covert strategies that may be especially critical for effective classroom learning and achievement are (1) accurately identifying important information and (2) regularly self-monitoring learning.

Identifying important information. The human memory system isn't a video or audio recorder; it simply can't take in and retain *all* the information a typical classroom curriculum presents. Thus, students must be quite selective when they're studying. The things they choose to study—whether main ideas and essential supporting details or, instead, isolated facts and trivia—inevitably affect their learning and school achievement (Dee-Lucas & Larkin, 1991; J. A. Dole, Duffy, Roehler, & Pearson, 1991; R. E. Reynolds & Shirey, 1988).

Students often have trouble identifying the most important information in a lesson or reading assignment, especially when they don't know very much about the topic at hand. Many use relatively superficial strategies in choosing what to focus on—for instance, zeroing in on definitions and formulas, taking notes only on things their teacher writes on the board, or reading only the first sentence of each paragraph of a textbook—and miss critical ideas as a result.

As teachers, we can, of course, simply tell students exactly what they should study. But we can also highlight important ideas through more subtle means:

- Provide a list of learning objectives for a lesson.
- Write key concepts and relationships on the board.
- Ask questions that focus students' attention on central ideas.

Students—low-achieving ones especially—are more likely to learn the essential points of a lesson when such prompts are provided for them (Kiewra, 1989; McCrudden & Schraw, 2007; R. E. Reynolds & Shirey, 1988; Schraw, Wade, & Kardash, 1993). As students become better able to distinguish between important and unimportant information on their own, we can gradually phase out our guidance.

Regularly monitoring learning. One very powerful learning strategy is comprehension monitoring, a process of periodically checking oneself for recall and understanding. How well do *you* monitor your comprehension? The following exercise can help you find out.

EXPERIENCING FIRSTHAND

LOOKING BACK

Stop for a minute and ask yourself this question:

What have I learned from this chapter so far?

Quickly jot down what you can recall.

Now go back and look at the pages preceding this one. Do the notes you've just written include all of the key points presented in those pages? Is there something you thought you understood but realize now that you don't? Is there something you never learned at all—perhaps something you were supposedly "reading" when your mind was thinking about something entirely different?

Successful learners continually monitor their comprehension both *while* they study something and at some point *after* they've studied it (Hacker, Dunlosky, & Graesser, 2009b). Furthermore, when they realize that they don't understand, they take steps to correct the situation, perhaps by rereading a section of a textbook or asking a question in class. In contrast, low achievers rarely check themselves or take appropriate action when they don't comprehend something. For example, they're unlikely to reread paragraphs they haven't understood the first time around (L. Baker & Brown, 1984; Haller, Child, & Walberg, 1988; Veenman, 2011).

Many children and adolescents engage in little or no comprehension monitoring (J. A. Dole et al., 1991; McKeown & Beck, 2009; Nokes & Dole, 2004). When they don't monitor their learning and comprehension, they don't know what they know and what they don't know; consequently, they may think they've mastered something when they really haven't. Although this

illusion of knowing is especially common in young children, it's seen in learners at all levels, even college students. As paper-and-pencil exams become increasingly prevalent at upper grade levels, an illusion of knowing can lead students to overestimate how well they'll perform on these assessments (Hacker, Bol, Horgan, & Rakow, 2000; Stone, 2000; Zimmerman & Moylan, 2009). For example, we authors occasionally have students come to us expressing frustration with low test scores. "I knew the material so well!" they might say. But as we begin to talk with them about the exam material, it usually becomes clear that they have only vague understandings of some ideas and incorrect understandings of others.

Comprehension monitoring doesn't have to be a solitary activity, of course. If students work in small study groups, they can easily test one another on classroom material and may detect gaps or misconceptions in one another's understandings (Bol, Hacker, Walck, & Nunnery, 2012; Dunning, Heath, & Suls, 2004; Vaughn et al., 2011). Ideally, the questions they ask one another should encourage them to elaborate on rather than simply recall what they're studying. For example, we might teach them to ask questions beginning with such phrases as *Explain why, What do you think would happen if,* and *What is the difference between* (A. King, 1992, p. 309).

Yet to be truly effective learners, students must ultimately learn how to test *themselves* as well. One effective strategy is self-explanation, in which students frequently stop to explain to themselves what they're studying (Berthold & Renkl, 2009; Fonseca & Chi, 2011; McNamara & Magliano, 2009). Another, similar approach is self-questioning, in which students periodically stop to ask themselves questions—essentially internalizing the mutual question-asking process they may have previously used in small-group study sessions. Their self-questions should, of course, include not only simple, fact-based questions but also elaborative ones (Bugg & McDaniel, 2012; Dunning et al., 2004; Wong, 1985).

FACTORS AFFECTING STRATEGY USE

As we've seen, students become increasingly capable of using effective learning strategies as they grow older, in part because they can better control and direct their cognitive processes. With age, too, comes an ever-expanding knowledge base that supports students' efforts to engage in elaboration, identify important information, and effectively monitor their comprehension. Several other factors also influence students' choice and use of various strategies, as reflected in the following principles.

- *Learning strategies depend partly on the learning task at hand.* In some situations teachers may assign tasks for which truly effective learning strategies are either counterproductive or impossible. For instance, if we insist that facts and definitions be learned verbatim, students will understandably be reluctant to engage in elaboration and other meaningful learning processes (Turner, 1995; Van Meter, Yokoi, & Pressley, 1994). And if we expect students to master a great deal of material for a single exam, they may have to devote their limited study time to getting only a superficial impression of everything or to studying only the easy material they're confident they can master (Son & Schwartz, 2002; J. W. Thomas, 1993b). Sometimes working memory's limited capacity discourages metacognitive processing: If a learning task involves thinking about a lot of information all at once—that is, if it imposes a heavy cognitive load—students may have insufficient "room" in working memory to use strategies that might otherwise be effective (Kalyuga, 2010; H. S. Waters & Kunnmann, 2010).
- *Students are likely to acquire and use new, more effective strategies only if they realize that their current strategies are not working.* Students will come to such a conclusion only if they have been regularly monitoring their comprehension in previous learning tasks and have become aware of their learning difficulties. Comprehension monitoring, then, doesn't just affect students' understanding of classroom subject matter—it also plays a pivotal role in the development of *other* metacognitive strategies (Kuhn, Garcia-Mila, Zohar, & Andersen, 1995; Lodico, Ghatala, Levin, Pressley, & Bell, 1983; Loranger, 1994). In some cases, too, feedback that students haven't yet mastered a learning task will spur them to adopt more effective strategies, at least for the short run (Starr & Lovett, 2000).
- *Students' beliefs about the nature of knowledge and learning influence their strategy choices.* One of us authors once had a conversation with her son Jeff, then an 11th grader, about the Canadian

Studies program that a local university had just added to its curriculum. Jeff's comments revealed a very simplistic view of what history is:

Jeff: The Canadians don't have as much history as we [Americans] do.

Mom: Of course they do.

Jeff: No they don't. They haven't had as many wars.

Mom: History's more than wars.

Jeff: Yeah, but the rest of that stuff is really boring.

Once Jeff reached college, he discovered that history is a lot more than wars and other "really boring" stuff. In fact, he majored in history and now, as a middle school teacher, actually *teaches* history. But it's unfortunate that he had to wait until college to discover the true nature of history as an academic discipline.

Children and adolescents have misconceptions about other subject areas as well. For example, in the opening case study, Ms. Gaunt's students think that math consists simply of a bunch of procedures that yield single right answers but don't necessarily have to make sense. Furthermore, many students have misconceptions about the general nature of learning. For instance, Ms. Gaunt's students think they should be able to learn mathematical concepts and procedures quickly and easily—with little or no effort on their part—so long as their teacher does her job.

Students' beliefs about the nature of knowledge and learning are collectively known as epistemic beliefs (you may also see the term *epistemological* beliefs). Such beliefs often influence studying and learning (Bendixen & Feucht, 2010; B. Hofer & Pintrich, 1997; Muis, 2007). For example, when students believe that learning happens quickly in an all-or-none fashion—as Ms. Gaunt's students apparently do—they're apt to think they've mastered something before they really have. Furthermore, they tend to give up quickly in the face of failure and express discouragement or dislike regarding the topic they're studying. In contrast, when students believe that learning is a gradual process that often takes time and effort, they're likely to use a wide variety of learning strategies as they study and to persist until they've made sense of the material (D. L. Butler & Winne, 1995; Kardash & Howell, 2000; Muis, 2007; Schommer, 1990, 1994b).

As another example of variability in learners' epistemic beliefs, some students believe that when they read a textbook, they're passively soaking up many separate pieces of information from the page. In contrast, other students recognize that learning from reading requires them to construct their own meanings by actively interpreting, organizing, and applying new information. Learners who realize that reading is a constructive, integrative process are more likely to engage in meaningful learning as they read and to undergo conceptual change when they encounter ideas that contradict their existing understandings (Mason, Gava, & Boldrin, 2008; Muis, 2007; Schommer-Aikins, 2002; Sinatra & Pintrich, 2003).

Epistemic beliefs tend to evolve over the course of childhood and adolescence (Kuhn & Park, 2005; Muis, Bendixen, & Haerle, 2006; Schommer, Calvert, Gariglietti, & Bajaj, 1997). Children in the elementary grades typically believe in the certainty of knowledge: They think that for any topic there's an absolute truth "out there" somewhere. As they reach high school, some of them—and *only* some—begin to realize that knowledge is a subjective entity and that different perspectives on a topic can occasionally be equally valid. Additional changes can occur over the course of the high school grades. For example, 12th graders are more likely than 9th graders to believe that knowledge consists of complex interrelationships rather than discrete facts and that most learning happens gradually over time rather than in a quick, one-shot effort. And throughout adolescence, students' epistemic beliefs become increasingly specific to particular content domains (Buehl & Alexander, 2006; Muis et al., 2006). For example, students may believe that, in math, answers are always either right or wrong (again recall Ms. Gaunt's students) but that in social studies conflicting perspectives might all have some validity. Such developmental trends are reflected in some of the entries in Table 7.1.

As teachers, we must communicate to students what we ourselves know to be true about knowledge and learning:

- Knowledge involves not only knowing facts, concepts, and ideas but also understanding interrelationships among these things.
- Learning involves active construction of knowledge, rather than just a passive absorption of it.
- Knowledge doesn't always mean having clear-cut answers to difficult, complex issues, and in some cases it involves critically evaluating available evidence relative to a particular point of view.
- Mastering a body of information or a complex skill often requires hard work and persistence.
- Human beings' collective knowledge about any topic or phenomenon is a dynamic, ever-evolving entity; thus, acquiring such knowledge must, by necessity, be an ongoing effort over the course of one's lifetime.

We should communicate such messages not only in what we say but also in what we *do,* such as in the questions we ask, the activities we assign, and the ways in which we assess students' learning. For example, we can have students address complex issues and problems that have no clear-cut right or wrong answers. We can teach students strategies for gathering data and testing competing hypotheses. We can ask students to compare several explanations of a particular phenomenon and consider the validity and strength of evidence supporting each one. And we can show students, perhaps by presenting puzzling phenomena, that their current understandings—and in some cases even those of experts in the field—don't yet adequately explain all of human experience (Andre & Windschitl, 2003; Bendixen & Feucht, 2010; Kuhn, 2009; Muis et al., 2006; Reznitskaya & Gregory, 2013; vanSledright & Limón, 2006). When we do such things, we increase the likelihood that students will apply effective learning strategies, critically evaluate classroom subject matter, and undergo conceptual change when appropriate (Bendixen & Feucht, 2010; B. Hofer & Pintrich, 2002; Sinatra & Pintrich, 2003).

We must be careful how far we take such strategies, however. When students are firmly rooted in *learning-involves-facts-that-I-can-get-only-from-an-expert* beliefs, they may initially find little of value in—and so may gain little from—lessons that emphasize diverse perspectives and offer few solid answers. Nudging students toward more sophisticated beliefs about the nature of knowledge can take time, gentle prodding, and persistence, as well as a classroom atmosphere in which students feel comfortable questioning their own and others' beliefs (Andre & Windschitl, 2003; Rule & Bendixen, 2010).

- *Different motives and goals call for different strategies.* Motivational factors clearly influence the extent to which students use effective strategies to learn and study. Some students may be more interested in getting by with a passing grade than truly mastering classroom material. Others may think that meaningful learning and other effective strategies involve too much time and effort to be worthwhile. Still others may have so little faith in their learning ability that they expect to do poorly regardless of the strategies they use (P. A. Alexander, Graham, & Harris, 1998; Mason, 2010; Nolen, 1996; Palmer & Goetz, 1988).
- *Ongoing instruction and guidance about effective strategies enhances learning and achievement.* With every transition to a higher educational level, teachers expect students to learn more material and to think about it in more sophisticated ways. Thus, the simple learning strategies children acquire in elementary school (e.g., rehearsal) become less and less effective with each passing year. All too often, however, teachers teach academic content areas—history, biology, math, and so on—without also teaching students how to *learn* in those content areas. When left to their own devices, most students develop effective strategies very slowly (if at all) and thus, over the years, encounter increasing difficulty in their attempts to master classroom subject matter. And when they *don't* master it, they may not know why they've failed or how to improve their chances of success the next time around (Hacker et al., 2000; Hamman, Berthelot, Saia, & Crowley, 2000; Nokes & Dole, 2004; O'Sullivan & Joy, 1994).

Using effective learning strategies makes such a difference in students' classroom achievement that we mustn't leave the development of these strategies to chance. How can we help students *learn how to learn?* The Into the Classroom feature "Promoting Effective Learning and Study Strategies" presents several research-based strategies. The most important of the strategies presented there is the first one: *When teaching academic content, simultaneously teach students how to effectively study and remember it.* Students are more likely to use effective learning and study strategies when those strategies are taught not in separate study-skills classes but rather as integral parts of everyday instruction about specific academic topics (Hattie, Biggs, & Purdie, 1996; S. G. Paris & Paris, 2001; Pressley, Harris, & Marks, 1992; Veenman, 2011).

METACOGNITIVE STRATEGIES IN THE DIGITAL AGE

In many traditional modes of instruction—teacher lectures and explanations, textbook readings, and the like—teachers or other knowledgeable individuals are largely in control of what students study and in what order they study it. In the 21st-century digital age, however, many instructional materials take the form of hypermedia, in which students can go from one electronic "page" to another one of their own choosing simply by clicking on a word, icon, or "button" on the screen. Hypermedia can be found both in prepackaged instructional software programs and in expert-designed instructional Internet websites. And, of course, the Internet itself is a virtually boundless form of hypermedia.

Acquiring new information from the Internet and other forms of hypermedia requires not only the kinds of learning strategies previously described but a few additional ones as well. Among other things, effective learners must do most or all the following when they use computer-based materials to acquire new information:

- Identify potentially productive keywords to use in a search for particular information
- Make good choices about paths and hotlinks to follow
- Critically evaluate the information and potential *mis*information they find on various websites (more on this issue in the discussion of critical thinking near the end of the chapter)
- Monitor their progress toward achieving key goals for their learning efforts
- Make adjustments in their goals and search strategies as new information comes to light
- Compare, contrast, and synthesize information obtained from two or more sources (Afflerbach & Cho, 2010; P. A. Alexander & the Disciplined Reading and Learning Research Laboratory, 2012; Azevedo & Witherspoon, 2009; Leu, O'Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009)

Many people of all ages don't have such skills, especially if they have little prior knowledge about a topic or naively assume that everything posted on the Internet must be "fact" (J. A. Greene, Hutchinson, Costa, & Crompton, 2012; P. A. Kirschner & van Merriënboer, 2013; Niederhauser, 2008). As you might guess, then, most elementary and secondary school students need considerable teacher guidance and scaffolding to learn effectively from hypermedia-based instructional resources.

Fortunately, some software programs are now emerging that explicitly scaffold students' learning strategies during computer-based instruction and online research (Azevedo, 2005; Koedinger, Aleven, Roll, & Baker, 2009; B. Y. White & Frederiksen, 2005). For example, a program might occasionally encourage students to set goals for their learning or ask them to identify causal relationships among concepts (Azevedo & Witherspoon, 2009; Graesser, McNamara, & VanLehn, 2005). And as students search the Internet for resources about a particular topic, computer-based scaffolding might occasionally remind them about their goal(s) in conducting the research or about the criteria they should use to evaluate the content of a particular website (Afflerbach & Cho, 2010; Quintana, Zhang, & Krajcik, 2005).

A good example of hypermedia with metacognitive scaffolding is *Betty's Brain,* a computer-based learning environment in which students read several resources about a topic, such as body temperature regulation or climate change, and then create a concept map representing the cause-and-effect relationships they discover in the resources. Students are told that a virtual "child" named Betty has to learn about the topic and that they can help her learn through the map they create as Betty's "teacher." Like a good teacher, they should also periodically assess her understanding with questions or a quiz. If Betty doesn't perform well, students can work to improve her understanding, and in the process they learn a great deal about the topic themselves. For example, Figure 7.2 shows an in-progress unit on climate change. The student/teacher has made some inappropriate causal links in her concept map, leading computer-based Betty to perform poorly on assessments. A virtual "mentor" (Mr. Davis) has stepped in to provide guidance about how to identify cause-and-effect relationships in a small section of text. Here the student has just correctly identified a relationship—*sea ice decreases absorbed light energy*—and Mr. Davis has suggested a good next step. (For more information about *Betty's Brain,* see Leelawong & Biswas, 2008; Segedy, Kinnebrew, & Biswas, 2013; also go to teachableagents.org.)

DIVERSITY, DISABILITIES, AND EXCEPTIONAL ABILITIES IN METACOGNITION

Researchers have observed cultural differences in students' epistemic beliefs—in particular, their beliefs about what it means to *learn* something. From the perspective of mainstream Western culture, learning is largely a mental enterprise: People learn in order to understand the world and acquire new skills and abilities. But for many people in China, learning also has moral and social dimensions: It enables an individual to become increasingly virtuous and honorable and to contribute in significant ways to the betterment of society.

Researchers have uncovered other cultural differences in learners' epistemic beliefs as well. For instance, beginning in middle school, students in the United States are more likely to question the validity of an authority figure's claims than are students in the Far East. In contrast, students in Far Eastern countries (e.g., Japan and Korea) are apt to believe that knowledge is cut-and-dried and can be effectively gained from authority figures (Kuhn & Park, 2005; Qian & Pan, 2002). Yet Asian learners—and also Asian American learners—have an advantage in another respect: Compared to their European American counterparts (who sometimes expect quick results with little work), students of Asian heritage are more likely to believe that mastering complex academic topics is often a slow, effortful process requiring diligence, persistence, and a combination of rote and meaningful learning (Dahlin & Watkins, 2000; J. Li, 2005; Morelli & Rothbaum, 2007; Schommer-Aikins & Easter, 2008; Tweed & Lehman, 2002).

ACCOMMODATING STUDENTS WITH SPECIAL NEEDS

We're especially likely to see diversity in metacognition in students who have special educational needs. Table 7.2 presents characteristics you might see in these students. Notice that many students with cognitive disabilities—and some with emotional and behavioral disorders as well—may exhibit little knowledge and use of effective learning strategies. In contrast, students who are gifted typically have more sophisticated learning strategies than their peers do.

For many students with disabilities, we may have to teach metacognitive skills explicitly and with considerable scaffolding—that is, with close guidance and assistance in the use of specific learning strategies (e.g., Boyle, 2011; Meltzer, 2007). For example, we might provide

STUDENTS IN INCLUSIVE SETTINGS

TABLE 7.2 • Promoting Metacognitive Development in Students with Special Educational Needs

CATEGORY	CHARACTERISTICS YOU MIGHT OBSERVE	SUGGESTED STRATEGIES
Students with specific cognitive or academic difficulties	• Less metacognitive awareness or control of learning • Use of few and relatively inefficient learning strategies • Increased strategy use after explicit instruction in strategies	Teach effective learning and reading strategies (e.g., taking notes, using mnemonics, identifying main ideas and general themes) within the context of lessons about particular topics. Model effective strategies and scaffold students' efforts to use them (e.g., provide outlines to guide note taking, ask questions that encourage activation of prior knowledge).
Students with social or behavioral problems	• Limited metacognitive awareness of one's processing difficulties (for some students) • Few effective learning strategies (for some students)	Provide guidance in using effective learning and study strategies (e.g., verbally model strategies, give outlines that guide note taking).
Students with general delays in cognitive and social functioning	• Lack of metacognitive awareness or control of learning • Lack of learning strategies, especially in the absence of strategies training	Teach relatively simple learning strategies (e.g., rehearsal, specific mnemonics), and give students ample practice in using them.
Students with physical or sensory challenges	• No consistently observed deficits in metacognitive knowledge or strategies; specific deficits sometimes due to sensory impairments	Address any deficits in metacognition with strategies you would use with nondisabled students, making appropriate accommodations for physical and sensory limitations.
Students with advanced cognitive development	• Use of relatively sophisticated learning strategies in comparison with peers	Don't assume that students have adultlike learning strategies; assess their existing strategies and, as appropriate, encourage more effective strategies (e.g., elaboration, comprehension monitoring). Provide opportunities for self-directed learning if students clearly have effective learning strategies they can use with little teacher guidance.

Sources: Beirne-Smith, Patton, & Kim, 2006; Boyle, 2011; Campione, Brown, & Bryant, 1985; B. Clark, 1997; Edmonds et al., 2009; E. S. Ellis & Friend, 1991; Graham & Harris, 1996; N. Gregg, 2009; Grodzinsky & Diamond, 1992; Heward, 2009; Mastropieri & Scruggs, 2007; McGlynn, 1998; Meltzer, 2007; Mercer & Pullen, 2005; Piirto, 1999; Pressley, 1995; Scruggs & Mastropieri, 1992; H. L. Swanson, 1993; Turnbull, Turnbull, & Wehmeyer, 2010; Waber, 2010; Wong, 1991.

partially filled-in outlines to guide students' note taking (e.g., see Figure 7.3). We might also tell students when particular strategies (e.g., elaboration, comprehension monitoring) are appropriate and model the use of such strategies with specific classroom subject matter. Finally, we must give students opportunities to practice their newly acquired strategies, along with feedback about how effectively they are using each one.

As teachers, we must remember that our students are likely to learn differently—and often less efficiently and successfully—than we do. Almost all of them can benefit from acquiring more sophisticated understandings of what knowledge and learning involve and from regularly practicing effective strategies for mastering school subject matter.

Transfer

How students think about and study school subject matter has implications not only for how well they can understand and remember it but also for how effectively they can *use and apply* it later on. Here we're talking about **transfer**: the extent to which knowledge and skills acquired in

FIGURE 7.3 **Example of a partially filled-in outline that can guide students' note taking**

MUSCLES

A. Number of Muscles

1. There are approximately _____ muscles in the human body.

B. How Muscles Work

1. Muscles work in two ways:
   a. They _____, or shorten.
   b. They _____, or lengthen.

C. Kinds of Muscles

1. _____ muscles are attached to the bones by _____.
   a. These muscles are _____ (voluntary/involuntary).
   b. The purpose of these muscles is to _____
   _____.
2. _____ muscles line some of the body's _____.
   a. These muscles are _____ (voluntary/involuntary).
   b. The purpose of these muscles is to _____
   _____.
3. The _____ muscle is the only one of its kind.
   a. This muscle is _____ (voluntary/involuntary).
   b. The purpose of this muscle is to _____
   _____.

one situation affect a person's learning or performance in a subsequent situation. Following are examples:

- Elena speaks both English and Spanish fluently. When she begins a French course in high school, she immediately recognizes many similarities between French and Spanish. "Aha," she thinks, "what I know about Spanish will help me learn French."
- In her middle school history class, Stella discovers that she does better on quizzes when she takes more notes. She decides to take more notes in her science class as well, and once again the strategy pays off.
- Ted's fifth-grade class has been working with decimals for several weeks. His teacher asks, "Which number is larger, 4.4 or 4.14?" Ted recalls something he knows about whole numbers: Numbers with three digits are larger than numbers with only two digits. "The larger number is 4.14," he mistakenly concludes.

In most cases prior learning *helps* learning or performance in another situation. Such positive transfer takes place when Elena's Spanish helps her learn French and when Stella's practice with note taking in history class improves her performance in science class. In some instances, however, existing knowledge or skills *hinder* later learning. Such negative transfer is the case for Ted, who transfers a principle related to whole numbers to a situation in which it doesn't apply: comparing decimals.

Sometimes we see specific transfer, in which the original learning task and the transfer task overlap in content. For example, Elena should have an easy time learning to count in French because the numbers (*un, deux, trois, quatre, cinq . . .*) are very similar to the Spanish ones she already knows (*uno, dos, tres, cuatro, cinco . . .*). At other times we may see general transfer, in which learning in one situation affects learning and performance in a somewhat dissimilar situation. Consider, for example, Stella's strategy of taking more notes in science because of her success with note

taking in history. History and science don't overlap much in content, but a strategy acquired in one class helps with learning in the other.

Historically, research studies have shown that when application of academic subject matter is involved, specific transfer occurs far more often than general transfer (S. M. Barnett & Ceci, 2002; W. D. Gray & Orasanu, 1987). In fact, the question of whether general transfer occurs at all has been the subject of considerable debate over the years. Many early educators believed that subject areas requiring considerable attention to precision and detail (e.g., math, Latin, and formal logic) might somehow strengthen students' minds and thereby enable students to tackle other, unrelated tasks more easily. This formal discipline perspective of transfer persisted throughout the first several decades of the 20th century. For instance, in the 1960s, when one of us authors was a high school student hoping to gain admission to a prestigious college, she was advised to take both French and Latin—the only two languages the school offered. "Why should I take Latin?" she asked. "I can use it only if I attend Catholic mass or run across phrases like 'caveat emptor' or 'e pluribus unum.'" The guidance counselor pursed her thin red lips and gave a look suggesting that she knew best. "Latin will discipline your mind," the counselor said. "It will help you learn better."

Most research has discredited this mind-as-muscle notion of transfer (Haskell, 2001; Perkins & Salomon, 1989; E. L. Thorndike, 1924). For example, practice in memorizing poems doesn't necessarily make one a faster poem memorizer (James, 1890). And studying computer programming, although often a worthwhile activity in its own right, doesn't necessarily help a person with dissimilar kinds of logical tasks (R. E. Mayer & Wittrock, 1996; Perkins & Salomon, 1989).

We're more likely to see general transfer when we broaden our notion of transfer to include application of general academic skills and learning strategies that can be applied to a wide variety of topics and contexts (e.g., reading comprehension, persuasive writing, and note taking) (J. R. Anderson, Greeno, Reder, & Simon, 2000; S. M. Barnett & Ceci, 2002; Perkins, 1995; M. I. Posner & Rothbart, 2007). Furthermore, general beliefs, attitudes, and dispositions related to learning and thinking—for instance, recognition that learning often requires hard work, as well as open-mindedness to diverse viewpoints—can have a profound impact on later learning and achievement across multiple domains, and so clearly illustrate general transfer at work (Cornoldi, 2010; De Corte, 2003; K. J. Pugh & Bergin, 2006; D. L. Schwartz, Bransford, & Sears, 2005). And some students develop a general desire to apply what they learn in the classroom—that is, they have a *spirit of transfer*—that consistently resurfaces in later instructional contexts (Goldstone & Day, 2012; Haskell, 2001; Volet, 1999).

FACTORS AFFECTING TRANSFER

Ideally, *positive* transfer to real-world contexts should be a major goal in classrooms at all grade levels. When learners can't use their basic math skills to compute correct change or balance a checkbook, when they can't use their knowledge of English grammar in a job application or business report, and when they can't apply their knowledge of science to an understanding of personal health or environmental problems, then we have to wonder whether the time spent learning these things might have been better spent doing something else.

Although both specific and general transfer do occur, students often *don't* apply the academic content they learn in particular classes to other classes or to out-of-school situations (Levstik, 2011; R. E. Mayer & Wittrock, 1996; Perkins & Salomon, 2012; Renkl, Mandl, & Gruber, 1996). Naturally, students are more likely to transfer what they learn at school when they approach each classroom topic with a deliberate intention to apply it. But several other factors also influence the probability of transfer, often because they influence learners' ability to *retrieve* what they've learned when they need to use it.

- *Meaningful learning promotes better transfer than rote learning.* Instructional time is clearly an important variable affecting transfer: The more time students spend studying a particular

topic, the more likely they are to apply what they've learned on future occasions. Ideally, students should gain a *conceptual understanding* of the topic—that is, they should have the many things they've learned appropriately organized and interrelated in long-term memory. Here we see an example of the general principle *Less is more:* Students are more likely to transfer their school learning to new situations, including those beyond the classroom, when they study a few things in depth and learn them meaningfully instead of studying many topics superficially (Brooks & Dansereau, 1987; Haskell, 2001; M. C. Linn, 2008; Schmidt & Bjork, 1992).

The *less-is-more* principle is clearly being violated in the opening case study. Ms. Gaunt decides that she must move fairly quickly if she is to cover the entire eighth-grade math curriculum, even if it means that few students will master any particular topic or procedure. Given the upcoming statewide math exam, she may have little alternative, but her students are unlikely to *use* what they're learning on future occasions.

- *Both positive and negative transfer are more common when a new situation appears to be similar to a previous one.* Perceived similarity increases the chances that a new situation will provide retrieval cues that point learners in the right direction as they search long-term memory for potentially relevant knowledge and skills (Bassok, 2003; Day & Goldstone, 2012; Haskell, 2001). For instance, when Elena first encounters number words in her French class (*un, deux, trois*), the words should quickly trigger recall of similar-sounding Spanish words (*uno, dos, tres*).

  However, we should note that the similarity of two situations, although usually promoting positive transfer, can sometimes lead to negative transfer instead. To see what we mean, try the following exercise.

EXPERIENCING FIRSTHAND

A DIVISION PROBLEM

Quickly estimate an answer to this division problem:

$$60 \div 0.38$$

Is your answer larger or smaller than 60? If you applied your knowledge of division by whole numbers, you undoubtedly concluded that the answer is smaller than 60. In fact, the answer is approximately 158, a number much *larger* than 60. Does this exercise remind you of Ted's erroneous conclusion—that 4.14 is larger than 4.4—based on his knowledge of how whole numbers can be compared? Even at the college level, many students show negative transfer of whole-number principles to situations involving decimals and fractions (M. Carr, 2010; Karl & Varma, 2010; Ni & Zhou, 2005). Working with decimals appears, on the surface, to be similar to working with whole numbers. The only difference—a very important one, as it turns out—is a tiny decimal point.

To minimize the likelihood that our students *negatively* transfer some of what they've previously learned, we must be sure to point out differences between two superficially similar topics. For example, Ted's teacher might have identified some of the specific ways in which decimals are different from whole numbers. As another example, we authors find that students in our educational psychology classes often have trouble correctly understanding certain concepts (e.g., *maturation, socialization, short-term memory*) because the meanings of these words in psychology are quite different from their meanings in everyday conversation. So when we first introduce one of these concepts, we take great pains to contrast the different meanings. Even so, students' everyday meanings regularly can intrude into their thinking about course content, especially if they don't continually monitor their own thinking and understanding.

- *General principles and theories are more easily transferred than discrete facts and task-specific procedures.* Some knowledge of specific facts and procedures is indispensable; for instance, students should know what 2 + 3 equals, where to find Africa on a globe, and how to draw a right angle. Yet by themselves, specific facts and procedures have only limited usefulness in new situations. On average, general principles, rules, and theoretical explanations are more

widely applicable than isolated bits of information and how-to-do-something-specific procedures (S. M. Barnett & Ceci, 2002; Bransford & Schwartz, 1999; Haskell, 2001; Kalyuga, Renkl, & Pass, 2010). The more we can emphasize general principles—for example, that adding two positive whole numbers always yields a larger number, that the cultures of various nations are influenced by their locations and climates, and that *cut, copy,* and *paste* functions are commonplace in computer applications—the more we facilitate students' ability to transfer what they learn. This is *not* to say, however, that we should always *begin* an instructional unit by teaching an abstract principle. Often it's better to begin with specific, concrete examples that engage students' interest and make immediate sense to them and only later introduce the general principle at work (Nathan, 2012; D. L. Schwartz, Chase, & Bransford, 2012).

Especially as they get older, some students acquire an ability to apply general principles to topics quite different from those they've previously studied. For example, in one research study, fifth graders and college students were asked to develop a plan for increasing the population of bald eagles, an endangered species in their state (Bransford & Schwartz, 1999). None of the students in either age-group had previously studied strategies for eagle preservation, and the plans that both groups developed were largely inadequate. Yet in the process of developing their plans, the college students addressed more sophisticated questions than the fifth graders did. In particular, the fifth graders focused on the eagles themselves (e.g., How big are they? What do they eat?), whereas the college students looked at the larger picture (e.g., What type of ecosystem supports eagles? What about predators of eagles and eagle babies?) (Bransford & Schwartz, 1999, p. 67). Thus, the college students were drawing on an important principle they had acquired in their many years of science study: Living creatures are more likely to survive and thrive when their habitat supports rather than threatens them.

- *Transfer is more common when information and skills are perceived as being relevant to diverse disciplines and real-world situations.* Unfortunately, many students tend to think of academic subject areas as *context bound*—that is, as being distinct disciplines that are completely separate from one another and from real-world concerns (P. A. Alexander & Judy, 1988; S. M. Barnett & Ceci, 2002; Perkins & Simmons, 1988; Renkl et al., 1996). For example, when baking cookies, an 11-year-old might ask a parent, "Do two one-quarters make two fourths? I know it does in math but what about in cooking?" (K. J. Pugh & Bergin, 2005, p. 16).

  The context-bound nature of some school learning may prevent students from retrieving what they've learned in situations where it might be useful. A classic study with high school students (Saljo & Wyndhamn, 1992) provides an illustration. Students were asked to figure out how much postage they should put on an envelope that had a certain weight, and they were given a table of postage rates that would enable them to determine the correct amount. When students were given the task in a social studies class, most used the postage table to find the answer. But when students were given the task in a math class, most of them ignored the postage table and tried to calculate the postage, in some cases figuring it to several decimal places. Thus, the students in the social studies class were more likely to solve the problem correctly, perhaps because they were well accustomed to looking for information in tables and charts in their social studies courses. In contrast, many of the students in the math class drew on strategies they associated with math, using formulas and performing calculations, and thus overlooked the more efficient and accurate approach.

  Fortunately, not all school learning remains "stuck" in school or in a particular classroom. People often apply some skills they've probably learned at school—such as reading, arithmetic, and map interpretation—to everyday, real-world tasks. But we can *increase* the transferability of school subject matter by regularly relating it to other disciplines and to the outside world (R. E. Clark & Blake, 1997; Perkins & Salomon, 2012; J. F. Wagner, 2010). For instance, we might show students how human digestion provides a justification for categorizing food into several basic food groups or how principles of economics have indirect impacts on global climate change.

- *Numerous and varied opportunities for practice increase the probability of transfer.* The more that students practice using what they've learned to address new tasks and problems—and the more *diverse* those tasks and problems are—the greater the probability that students will

apply school subject matter in future situations, including those outside the classroom (Gijbels, Dochy, Van den Bossche, & Segers, 2005; Gresalfi & Lester, 2009; J. F. Wagner, 2010). Especially helpful are **authentic activities**—activities similar or identical to those that students will eventually encounter in real-world contexts. For example, when students are learning basic arithmetic principles, they might be asked to apply those principles in determining best buys at a discount store, dividing items equitably among friends, and running a school book sale. Arithmetic will then be associated in long-term memory with all of these situations, and when the need arises to determine which of two purchases yields the most for the money, relevant mathematical procedures should be readily retrieved. Ideally, students should discover that much of what they learn at school truly has wide applicability—in other words, school topics become *context free* (A. Collins, Brown, & Newman, 1989; Cox, 1997; Perkins & Salomon, 1989).

- *Transfer increases when the cultural environment encourages and expects transfer.* All too often, it seems, students are encouraged to acquire school subject matter for mysterious purposes—for example, "You'll need to know this in college" or "It will come in handy later in life." Ideally, we should instead create a **culture of transfer**—a learning environment in which applying school subject matter to new situations, cross-disciplinary contexts, and real-world problems is both the expectation and the norm. For instance, we might regularly encourage students to ask themselves *How might I use this information?* as they listen, read, and study (R. A. Engle, Lam, Meyer, & Nix, 2012; Gresalfi & Lester, 2009; Haskell, 2001; Perkins & Salomon, 2012; Pea, 1987).

Problem Solving

Problem solving involves using—that is, *transferring*—existing knowledge and skills to address an unanswered question or troubling situation. The world presents many, many problems that differ widely in content and scope, as illustrated in the next exercise.

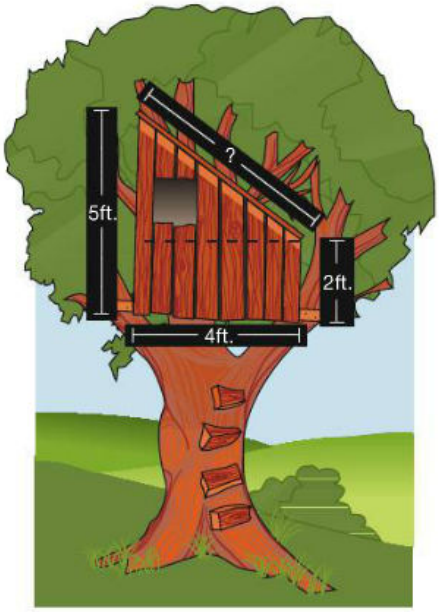


FIGURE 7.4 How long do the roof planks of this treehouse need to be?

EXPERIENCING FIRSTHAND
FOUR PROBLEMS

How many of these problems can you solve?

1. You buy two apples for 25 cents each and one orange for 40 cents. How much change will you get back from a dollar bill?
2. You're building a treehouse with the shape and dimensions illustrated in Figure 7.4. You need to buy planks for a slanted roof. How long must the roof planks be to reach from one side of the treehouse to the other?
3. As a teacher, you want to illustrate the idea that metal battleships float even though metal is denser (and thus heavier) than water. You don't have a toy boat made of metal. What can you use instead to demonstrate that a metal object with a hollow interior can float on water?
4. Tropical rainforests provide homes for many species of animals and plants—including some plants useful in modern medicine—and they help to reduce the rapid increase in carbon dioxide in the earth's atmosphere. Yet each day tens of thousands of acres of tropical rainforest disappear, largely as a result of farmers' efforts to create new farmland by slashing and burning existing vegetation. What steps might be taken to curtail this alarming rate of deforestation?

Sometimes problems are straightforward and easy to solve. Problem 1 requires only simple addition and subtraction procedures, which readily yield a correct solution: 10 cents. Problem 2 (Figure 7.4) is more difficult, partly because you probably don't encounter such problems very often. But if you've studied geometry, you've almost certainly learned the Pythagorean theorem: In any right triangle, the square of the hypotenuse equals the sum of the squares of the other two sides. Looking at the top part of the treehouse (from the dashed line upward) as a triangle, we can find the length for the roof planks (x) this way:

$$(\text{Slanted side})^2 = (\text{Horizontal side})^2 + (\text{Vertical side})^2$$
$$x^2 = 4^2 + (5 - 2)^2$$
$$x^2 = 16 + 9$$
$$x^2 = 25$$
$$x = 5$$

Problems don't always have a single correct solution, of course. For instance, a variety of objects might be used to solve Problem 3; a metal pie plate and a bucket are two possibilities. And you might identify several possible ways of addressing Problem 4, but you probably wouldn't know which ones could successfully curtail rainforest destruction until you actually implemented them.

Problems differ considerably in the extent to which they're clearly specified and structured. At one end of this clarity-and-structure continuum is the well-defined problem, in which the goal is clearly stated, all information needed to solve the problem is present, and only one correct answer exists. Calculating correct change after a purchase (Problem 1) and determining the length of planks needed for a treehouse roof (Problem 2) are well-defined problems. At the other end of the continuum is the ill-defined problem, in which the desired goal is unclear, information needed to solve the problem is missing, or several possible solutions may exist. Finding a suitable substitute for a metal ship (Problem 3) is somewhat ill defined: Many objects might serve as a ship substitute, and some might work better than others. The rainforest destruction problem (Problem 4) is even less defined: The goal (curtailing deforestation) is ambiguous, we're missing a lot of information that would help us solve the problem (e.g., what alternatives might replace farmers' slash-and-burn practices?), and there's no single correct solution. On average, ill-defined problems are harder to solve than well-defined ones.

Most problems presented in school are well defined. As an example, let's return to the typing problem in the opening case study:

> Clifford can type 35 words a minute. He needs to type a final copy of his English composition, which is 4,200 words long. How long will it take Clifford to type his paper?

Notice that all the information needed to solve the problem is provided, and there's no irrelevant information to lead students astray. And if Clifford continues to type at the same pace, there's only one correct answer. Yet the real world presents ill-defined problems far more often than well-defined ones, and students need practice in dealing with them. Furthermore, when students regularly encounter ill-defined problems in the school curriculum, they may acquire more sophisticated epistemic beliefs—in particular, they may begin to realize that many topics and issues don't have easy, clear-cut right and wrong answers (Rule & Bendixen, 2010).

Taking the perspective of cognitive psychology (especially information processing theory), you might think of problem solving as involving five basic steps:

1. Encoding the problem
2. Retrieving one or more strategies that might be useful in solving the problem
3. Choosing the most appropriate strategy or set of strategies
4. Carrying out the chosen strategy or strategies
5. Evaluating the quality of the problem solution obtained (steps based loosely on Polya, 1957)

Cognitive factors we've previously identified as affecting transfer—such as thorough understanding of a topic and perceived relevance of new information to diverse contexts—certainly affect learners' ability to carry out these steps successfully. Researchers have identified additional factors

related to four general categories: problem encoding, problem-solving strategies, working memory capacity, and metacognition.

PROBLEM ENCODING

At Step 1 in the problem-solving process, learners might mentally represent a problem—that is, they might encode it—in a variety of ways. As an example, try to solve the problem in the following exercise.

EXPERIENCING FIRSTHAND

PIGS AND CHICKENS

See if you can solve this problem before you read any further:

> Old MacDonald has a barnyard full of pigs and chickens. Altogether there are 21 heads and 60 legs in the barnyard (not counting MacDonald's own head and legs). How many pigs and how many chickens are running around the barnyard?

If you're having trouble figuring out the answer, think about the problem this way:

> Imagine the pigs standing upright on their two hind legs, with their two front legs raised over their heads. Therefore, both the pigs and the chickens are standing on two legs. Figure out how many legs are on the ground and how many must be in the air. From this information, can you determine the number of pigs and chickens in the barnyard?

Because there are 21 heads, there must be 21 animals. Thus, there must be 42 legs on the ground (21 × 2), which leaves 18 pigs' legs in the air (60 – 42). There must therefore be 9 pigs (18 ÷ 2) and 12 chickens (21 – 9).

There are several ways you might approach the pigs-and-chickens problem. But if you initially had trouble solving it—perhaps because your algebra skills are rusty—you may have struggled to encode it in a way that led you to an easy solution. Students often have difficulty solving mathematical word problems because they don't know how to translate the problems into procedures they've studied (K. Lee, Ng, & Ng, 2009; R. E. Mayer, 1992; Walkington, Sherman, & Petrosino, 2012).

At other times students may encode a problem in a seemingly logical way that nevertheless fails to yield a workable result. As an example, take a stab at the next problem.

EXPERIENCING FIRSTHAND

CANDLE PROBLEM

How might you stand a candle upright in front of a bulletin board attached to the wall? You don't want the candle to touch the bulletin board, because the flame might singe the board. Instead, you need to place the candle about a centimeter away from the board. How can you accomplish the task using some or all of the following materials: a small candle (birthday cake size), a metal knitting needle, matches, a box of thumbtacks, and a 12-inch ruler?

Source: Based on Duncker, 1945.

As it turns out, the ruler and knitting needle are useless in solving the problem. Piercing the candle with the knitting needle will probably break the candle, and you're unlikely to have much luck balancing the ruler on a few tacks. (One of us authors speaks from experience here, as some of her own students have unsuccessfully tried both strategies.) The easiest solution is to turn the thumbtack box upside down or sideways, attach it to the bulletin board with tacks, and then attach the candle to the top of the box with either a tack or melted wax. Many people don't consider this possibility because they encode the box only as a *container of tacks* and so overlook its potential use as a candle stand. When learners encode a problem in a way that limits possible solutions, they're the victims of a **mental set**. Mental sets, then, interfere with Step 2 in the problem-solving process: retrieving potentially useful strategies from long-term memory.

PROBLEM-SOLVING STRATEGIES: ALGORITHMS AND HEURISTICS

At the heart of successful problem solving are the *strategies* learners have available to them, as reflected in Steps 2, 3, and 4 of the problem-solving process described earlier. Some problems can be successfully solved with an algorithm—a specific sequence of steps that guarantees a correct solution. For example, by dividing 4,200 by 35, we can easily determine that Clifford will need 120 minutes (2 hours) to type his English composition. And by using the Pythagorean theorem and simple algebra, we can correctly calculate the length of a treehouse's slanted roof.

Yet the world presents many problems for which no algorithms exist. There are no rules we can follow to identify a substitute metal ship, no set of instructions to help us address worldwide rainforest destruction. In fact, few algorithms exist for solving problems outside the domains of mathematics and science. In the absence of an algorithm, learners must use one or more heuristics—general problem-solving strategies that may or may not yield a successful outcome. For example, one heuristic we might use in solving the deforestation problem is this: Identify a new behavior that adequately replaces the problem behavior (i.e., identify another way that rainforest farmers can successfully address their survival needs).

Both types of problem-solving strategies—algorithms and heuristics alike—are often specific to particular content domains. But here are several general problem-solving heuristics that can be helpful in a variety of contexts:

- *Identify subgoals.* Break a large, complex task into two or more specific subtasks that can be more easily addressed.
- *Round complex numbers up or down.* Estimate mathematical solutions by converting hard-to-work-with numbers to simpler ones.
- *Use paper and pencil.* Draw a diagram, list a problem's components, or jot down potential solutions or approaches.
- *Draw an analogy.* Identify a situation analogous to the problem situation, and derive potential solutions from the analogy.

WORKING MEMORY AND PROBLEM SOLVING

Remember, working memory has a limited capacity: At any one time it can hold only a few pieces of information and accommodate only so much cognitive processing. If a problem requires dealing with a lot of information at once or manipulating that information in a very complex way—when the *cognitive load* is high—working memory capacity may be insufficient for effective problem processing (K. Lee et al., 2009; Moreno & Park, 2010; H. L. Swanson, Jerman, & Zheng, 2008). Thus, working memory places an upper limit on Step 4 in the problem-solving process: successfully carrying out chosen strategies.

Learners can overcome the limits of working memory in at least two ways. One obvious strategy is to create an external record of needed information—for example, by writing it on a

piece of paper (as we sometimes do with long division problems). Another approach is to learn some skills to automaticity—in other words, to learn them so well that they can be retrieved quickly and easily (N. Frederiksen, 1984a; R. E. Mayer & Wittrock, 2006; Sweller, 1994).

METACOGNITION IN PROBLEM SOLVING

Successful problem solving often involves considerable metacognitive involvement. Especially when problems are fairly complex and challenging, effective problem solvers tend to engage in metacognitive process at all five steps of the problem-solving process—for example, by doing the following:

- Identifying one or more goals that must be accomplished to solve the problem
- Breaking the problem into two or more subproblems
- Planning a systematic, sequential approach to solving the problem and its subproblems
- Continually monitoring and evaluating their progress toward the problem-solving goal(s)
- Identifying obstacles that may be impeding their progress
- Changing to a new strategy if the current one isn't working
- Scrutinizing the final solution to make sure that it's logical and realistic (M. Carr, 2010; J. E. Davidson & Sternberg, 1998, 2003; Dominowski, 1998; Kirsh, 2009)

Such actions enable learners to use problem-solving strategies flexibly and to determine when particular strategies aren't appropriate. In contrast, *in*effective problem solvers tend to apply problem-solving procedures mindlessly, without any real understanding of what they're doing or why they're doing it. In the opening case study, Ms. Gaunt's students rarely critique their problem solutions for logical sense; thus, they may not recognize that typing a 4,200-word paper is unlikely to take 100 days.

To some extent, students' metacognitive problem-solving processes depend on their conceptual understanding of the subject matter (M. Carr & Biddlecomb, 1998; J. E. Davidson & Sternberg, 1998; Rittle-Johnson & Star, 2009). Yet students also benefit from instruction and guidance in metacognitive strategies. Following are several strategies we teachers can use:

- Ask students to explain what they're doing and why they're doing it as they work on a problem.
- Give students questions they can ask themselves as they work on a problem (e.g., "Am I getting closer to my goal?" "Why is this strategy the best one to use?").
- Help students to identify common errors in their problem solving and to check regularly for these errors.
- Ask students to reflect on their problem solutions to determine whether the solutions make sense within the context of the original problems. (M. Carr, 2010; Dominowski, 1998; Johanning, D'Agostino, Steele, & Shumow, 1999; A. King, 1999; Kramarski & Mevarech, 2003, p. 286; Roditi & Steinberg, 2007; Siegler, 2002)

Such approaches can be especially effective when students work on challenging problems with one or more classmates and must explain and defend their reasoning to their peers.

Creativity

Creativity, like problem solving, is a form of transfer, because it involves applying previously learned knowledge or skills to a new situation. Psychologists have offered varying opinions about its nature, but in general creativity has two components:

- *New and original behavior:* Behavior not specifically learned from someone else
- *A productive result:* An outcome appropriate for, and in some way valuable to, one's culture (e.g., Beghetto & Kaufman, 2010; Runco & Chand, 1995; R. K. Sawyer, 2003)

To illustrate these two components, let's say that one of your instructors is conducting a lesson on creativity and wants a creative way of keeping students' attention. One possible approach would be to come to class stark naked. This approach certainly meets the first criterion for creativity (it's new and original) but not the second criterion (it isn't appropriate in our culture). An alternative strategy might be to give students several challenging problems that require creative thinking. This approach is more likely to meet both criteria: Not only is it a relatively original way of teaching, but it's also appropriate and productive for students to learn about creativity by exploring the process firsthand.

Many complex tasks involve both problem solving and creativity. But the two processes differ somewhat in the extent to which they involve convergent thinking versus divergent thinking, both of which are illustrated in Figure 7.7. To successfully tackle a problem, we typically pull together two or more pieces of information into an integrated whole that resolves the problem. This combining of information into a single idea or product is known as convergent thinking. In contrast, when we engage in creativity, we often begin with a single idea and take it in a variety of directions, at least one of which leads to something that's new, original, and culturally appropriate. This process of generating many different ideas from a single starting point is known as divergent thinking. To see the difference firsthand, try the next exercise.

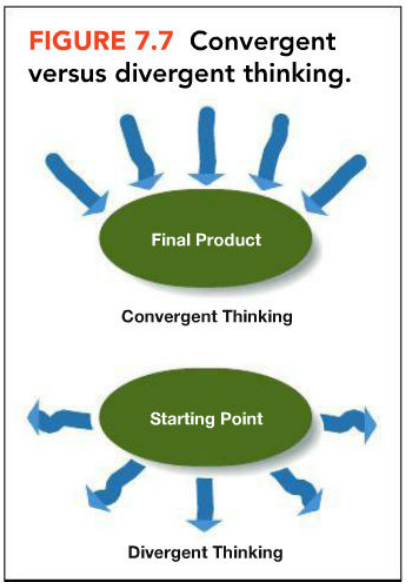


FIGURE 7.7 Convergent versus divergent thinking.

EXPERIENCING FIRSTHAND
CONVERGENT AND DIVERGENT THINKING

On a sheet of paper, write your responses to each of the following:

1. Why are houses more often built with bricks than with stones?
2. What are some possible uses of a brick? Try to think of as many different and unusual uses as you can.
3. Add improvements to the wagon drawing so that the object will be more fun to play with.

Source: Items 2 and 3 modeled after Torrance, 1970.

To answer the first question, you must use convergent thinking to pull together the things you know about bricks, stones, and building construction. But the other two items require divergent thinking about a single object: You must consider how a brick might be used in different contexts and how different parts of the wagon might be embellished—with some of your responses being novel and unique.

Contrary to a popular belief, creativity is *not* a single entity that people either have or don't have. Rather, it's probably a combination of many specific thinking processes, motives, and behaviors. Among other things, creative individuals tend to have the following characteristics:

- Considerable knowledge relevant to the task at hand
- Ability to interpret problems and situations in a flexible, open-minded manner and to combine existing information and ideas in new ways
- Passion for—and thus a willingness to invest a good deal of time and effort in—what they're doing
- Persistence in trying out various approaches, with acceptance of the many failures and dead-ends that they're likely to encounter before finally creating a satisfactory product (Amabile, 1996; Csikszentmihalyi, 1996; Leung, Maddux, Galinsky, & Chiu, 2008; Runco & Chand, 1995; Russ, 1993; Simonton, 2004, 2011; Weisberg, 1993)

Furthermore, creativity is often specific to particular situations and content areas (Dai, 2010; Glover, Ronning, & Reynolds, 1989; Runco, 2004). For example, students might show creativity in art, writing, or science but won't necessarily be creative in all of these areas.

FOSTERING CREATIVITY

Certain aspects of creative thinking may have their roots in hereditary factors, but environmental factors play an equally important role in the development of creativity (Esquivel, 1995; Ripple, 1989; Simonton, 2000). In fact, because creativity requires considerable expertise and fairly sophisticated thought processes, learners are apt to become increasingly creative as they grow older, gain diverse experiences and perspectives—ideally including *multicultural* experiences and perspectives—and have numerous opportunities to experiment with objects and ideas (Hatano & Oura, 2003; Leung et al., 2008; Simonton, 2004).

Critical Thinking

Different theorists define critical thinking somewhat differently, but for our purposes here we'll define critical thinking as evaluating the accuracy, credibility, and worth of information and lines of reasoning. Critical thinking is reflective, logical, and evidence-based. It also has a purposeful quality to it—that is, the learner thinks critically in order to achieve a particular goal (Beyer, 1985; Bonney & Sternberg, 2011; Halpern, 2008; Moon, 2008).

Critical thinking can take a variety of forms, depending on the context. The following exercise presents four possibilities.

EXPERIENCING FIRSTHAND

COLDS, CARS, CHANCE, AND CHEER

Read and respond to each of the following situations:

1. It's autumn, and the days are becoming increasingly chilly. You see the following advertisement:

   Aren't you tired of sniffles and runny noses all winter? Tired of always feeling less than your best? Get through a whole winter without colds. Take Eradicold Pills as directed. (R. J. Harris, 1977, p. 605)

   Should you go out and buy a box of Eradicold Pills?

2. You have a beat-up old car and have invested several thousand dollars to get it in working order. You can sell the car in its present condition for $1,500, or you can invest a couple of thousand dollars more on repairs and then sell it for $3,000. What should you do? (modeled after Halpern, 1998)

3. You have been rolling a typical six-sided die (i.e., one member of a pair of dice). You know that the die isn't heavier on one side than another, and yet in the past 30 rolls you haven't rolled a number 4 even once. What are the odds that you'll get a 4 on the next roll?

4. This research finding was presented by Dr. Edmund Emmer at the annual conference of the American Educational Research Association in 1994:

   Teachers who feel happy when they teach are more likely to have well-behaved students (Emmer, 1994).

   If you're a teacher, do such results suggest that you should try to feel happy when you enter the classroom each morning?

In each of these situations, you had to evaluate information and make some sort of judgment. In Item 1, we authors hope you weren't tempted to buy Eradicold Pills, because the advertisement provided no proof that they reduce cold symptoms. It simply included the suggestion to "Take Eradicold Pills as directed" within the context of a discussion of undesirable symptoms—a common ploy in persuasive advertising.

As for Item 2, it makes more sense to sell the car now. If you sell the car for $3,000 after making $2,000 worth of repairs, you'll make $500 less than you would otherwise. Many people mistakenly believe that their past investments justify making additional ones, when in fact past investments are irrelevant to the present circumstances (Halpern, 1998).

In Item 3 the chance of rolling a 4 on an evenly balanced die is—as always—one in six. The outcomes of previous rolls are irrelevant, because each roll is independent of the others. But when a 4 hasn't shown up even once in 30 rolls, many people believe that a 4 is long overdue and so greatly overestimate its probability—a misconception known as the *gambler's fallacy.*

Now what about making sure that you're happy each time you enter the classroom (Item 4)? One common mistake people make in interpreting research results is to think that an association (*correlation*) between two things means that one of those things must *cause* the other. In fact, however, a correlation between two variables doesn't necessarily indicate a cause-and-effect relationship. Possibly teacher happiness does improve students' classroom behavior, but there are other potential explanations for the correlation as well. For instance, perhaps good student behavior makes teachers feel happy (rather than vice versa), or perhaps teachers who feel upbeat use more effective teaching techniques and can better keep students on task as the result of using those techniques (Emmer, 1994).

The four situations presented in the preceding exercise illustrate several forms that critical thinking can take (Halpern, 1997, 1998, 2008; Nussbaum, 2008):

- *Verbal reasoning:* Understanding and evaluating persuasive techniques found in oral and written language. You engaged in verbal reasoning when deciding whether to purchase Eradicold Pills.

- *Argument analysis:* Discriminating between reasons that do and don't support a conclusion. You engaged in argument analysis when you considered possible pros and cons of investing an additional $2,000 in car repairs.
- *Probabilistic reasoning:* Determining the likelihood and uncertainties associated with various events. You engaged in probabilistic reasoning when you determined the probability of rolling a 4 on the die.
- *Hypothesis testing:* Judging the value of data and research results in terms of the methods used to obtain them and their potential relevance to certain conclusions. When hypothesis testing includes critical thinking, it involves considering questions such as these:
  - Was an appropriate instrument used to measure a particular outcome?
  - Have other possible explanations or conclusions been eliminated?
  - Can the results obtained in one situation be reasonably generalized to other situations?

  You engaged in hypothesis testing when you evaluated Dr. Emmer's findings about teacher happiness.

Some theorists have argued that critical thinking involves a general set of cognitive skills that learners can apply broadly in many different contexts (e.g., Ennis, 1996). But in fact, the nature of critical thinking is somewhat specific to various content domains. In writing, critical thinking might involve reading the first draft of a persuasive essay to look for errors in logical reasoning or for situations in which opinions haven't been sufficiently justified. In science, it might involve revising existing theories or beliefs to account for new evidence—that is, it may involve conceptual change. In history, it might involve drawing inferences from historical documents, attempting to determine whether things *definitely* happened a particular way or only *maybe* happened that way.

As you might guess, critical thinking skills emerge gradually over the course of childhood and adolescence (Amsterlaw, 2006; Kuhn & Franklin, 2006; Pillow, 2002). Yet all too often, students at all grade levels—and even many well-educated adults—take the information they see in textbooks, in news reports, on the Internet, and elsewhere at face value. In other words, they engage in little or no critical thinking as they consider the accuracy, credibility, and worth of the information they encounter (Kuhn, 2009; Marcus, 2008; Metzger, Flanagin, & Zwarun, 2003; Sinatra, Kienhues, & Hofer, 2014).

To some degree, learners' tendencies to think or not think critically depend on certain personality characteristics: On average, critical thinkers are open-minded, enjoy intellectual challenges, and can emotionally handle the idea that they might occasionally be wrong about a topic (Halpern, 2008; Moon, 2008; Schraw, McCrudden, Lehman, & Hoffman, 2011). Learners' epistemic beliefs also come into play. Learners are more likely to look analytically and critically at new information if they believe that even experts' understanding of a topic continues to evolve as new evidence accumulates. They're *un*likely to engage in critical thinking if, instead, they believe that knowledge is an absolute, unchanging entity (P. M. King & Kitchener, 2002; Kuhn, 2001a; Muis & Franco, 2009; Schommer-Aikins, 2002).

FOSTERING CRITICAL THINKING

To become effective life-long learners, students must learn that not all sources of information can be trusted—that some messages presented through various media are either misleading or downright wrong. In our current era of ever-expanding information technology and social media, taking a critical stance toward new information is now more important than ever. For example, although entries in the popular website Wikipedia are generally accurate, they occasionally include inaccuracies added by nonexperts. Furthermore, virtually anyone can post personal beliefs and opinions somewhere on the Internet—often presenting these things as irrefutable "facts"—and it's quite easy to be taken in. Unfortunately, many people at all age levels naively assume that almost everything they read on the Internet is fact (Manning, Lawless, Goldman, & Braasch, 2011; Metzger, Flanagin, & Zwarun, 2003; Wiley et al., 2009).

Diversity in Creativity, Critical Thinking, and Other Complex Cognitive Processes

We might reasonably speculate that Western schools' focus on meaningful learning and conceptual understanding enhances students' ability to be creative: One recent study with college students found students from a European American background to be especially proficient in solving math problems requiring creative thinking (Schommer-Aikins & Easter, 2008). Perhaps more significant, however, has been the finding that experiences in *two or more cultures* enhance creative thinking and behaviors. Quite possibly, such a multicultural background exposes learners to a broader range of concepts, ideas, and perspectives from which to draw when trying to think about a topic or problem in nontraditional ways (Leung et al., 2008).

Critical thinking is another complex cognitive process that seems to depend somewhat on students' cultural backgrounds. Some cultures place high value on respecting one's elders or certain religious leaders, and in doing so, they may foster the belief that "truth" is a cut-and-dried entity that is best gained from authority figures (Losh, 2003; Qian & Pan, 2002; Tyler, Uqdah, et al., 2008). Furthermore, a cultural emphasis on maintaining group harmony may discourage children from hashing out differences in perspectives, which critical thinking often entails (Kağitçibaşi, 2007; Kuhn & Park, 2005). Perhaps as a result of such factors, critical thinking may be less common in some groups (e.g., in some traditional Asian and Native American communities and in

ACCOMMODATING STUDENTS WITH SPECIAL NEEDS

In addition to differences that might be a function of cultural background, researchers have observed differences in complex thinking skills for students with various disabilities and for students who have advanced cognitive abilities. Table 7.3 presents some of the characteristics you're likely to see in students with special educational needs, along with recommendations for working with these students.

Islamic Online University
Lecture Notes for Modules 15 & 16

TEXTBOOK CHAPTER 8: LEARNING AND COGNITION IN CONTEXT

LEARNING OUTCOMES

1 Describe five basic assumptions underlying contextual theories of learning, and apply these assumptions to classroom practice.
2 Contrast the benefits of expert--novice interactions with the benefits of peer interactions: explain how you might enhance students' learning through both kinds of interactions.
3 Explain how learners' cultural backgrounds can influence their interpretations of new information and experiences; also explain how learners can effectively begin to participate in one or more communities or practice.
4 Describe key elements of society that impact learning, and explain how authentic activities can enhance learners' performance in their out-of-school lives.
5 Describe the unique roles that digital technologies and the Internet can play in classroom instruction.
6 Apply your knowledge of learning, cognition, and effective instructional practices to various academic content domains.

As cognitive psychologists have explained, human learning typically involves *meaningful* learning—connecting new information and experiences to existing knowledge and beliefs about the world. Often, in fact, people engage in *elaboration*, embellishing on and sometimes distorting new input so that it's a good fit with their current understandings. To the extent that different people retrieve different knowledge and beliefs in any given situation, they're likely to interpret that situation in very different ways. For example, Jacob may have retrieved information about undesirable behaviors in the 20th century—perhaps the rise of organized crime in the 1920s or the increasing popularity of illegal drugs beginning in the late 1960s. In contrast, Howard apparently retrieved his knowledge of the rigidity and intolerant religious practices of many Puritans in the Massachusetts Bay Colony of the 17th century.

But *why* did the boys retrieve different prior knowledge and elaborate on the information in distinctly different ways? In her study, Mosborg (2002) discovered one important factor that seemed to make a difference: the broader social context in which students had grown up. Some students in the study were, like Jacob, attending an interdenominational religious school that stressed adherence to certain principles of Christianity. Other students, like Howard, attended a more secular private school that focused only on traditional academic disciplines. Presumably the students' schools reflected their parents' priorities, beliefs, and values—all of which the parents wanted to pass along to their children.

Learning always take place within particular *contexts*—for instance, within a particular classroom environment, social group, culture, and society. Furthermore, in those societies where children attend school, instruction is typically divided into discrete content domains—such as reading, math, science, and history—that involve somewhat idiosyncratic kinds of knowledge and skills. Such social and content-specific contexts for learning are the subjects of this chapter.

Basic Assumptions of Contextual Theories

Cognitive theories of learning—information processing theory, individual constructivism, and related perspectives—tell us a great deal about how human beings learn and develop. But in recent decades psychologists have become increasingly aware that people's learning and development are inextricably dependent on and bound to various physical, social, and cultural contexts. Many of these psychologists have been influenced by Russian psychologist Lev Vygotsky's early theory of cognitive development and American psychologist Urie Bronfenbrenner's subsequent bioecological systems theory; hence, as you will soon discover, the e-book version of this chapter includes links to resources that depict key ideas in Vygotsky's and Bronfenbrenner's theories.

Contextual theories of learning vary considerably in the particular contexts they emphasize. Even so, they tend to share most or all of the following assumptions.

- *The brain functions in close collaboration with—rather than in isolation from—the rest of the body.* Obviously the brain can't function without good nutrition and the health of the rest of the body, and it gets new information from the eyes, ears, and other sensory organs. But in addition, thinking and learning are often intimately intertwined with a learner's physical actions and reactions. For example, when we think about throwing a baseball, we activate parts of the brain that control arm and hand muscles involved in throwing even if we aren't actually moving those muscles (Spunt, Falk, & Lieberman, 2010). And when we're pondering complex situations—perhaps math problems or perhaps the shapes and locations of various objects in space—gesturing with our hands or arms can sometimes help us think and talk about the situations more effectively (Alibali, Spencer, Knox, & Kita, 2011; Goldin-Meadow & Beilock, 2010; Segal, Tversky, & Black, 2014).
- *Acquired knowledge and skills are often tied to specific physical, social, or cultural activities and environments.* People don't always use what they've learned in situations where it might be relevant—a phenomenon known as **situated learning** or **situated cognition**. In some cases, people have associated new information and skills only with particular kinds of tasks or problems; for example, they might be accustomed to using their knowledge of algebra in a math class but *not* accustomed to using it—and hence they don't retrieve it—in relevant real-world activities such as constructing a treehouse, sewing a new vest, or choosing a sensible mortgage plan. In other cases, people may simply find it *easier* to use newly learned ideas or skills in certain contexts because these contexts provide physical, social, or cultural support for applying the new knowledge—as you'll see in the discussions of the next two assumptions.
- *Learners often think and perform more effectively when they can offload some of the cognitive burden onto something or someone else.* As you should recall from information processing theory, active cognitive processing takes place in working memory, which—*by itself*—can handle only a small amount of information at any one time. For complex tasks, then, it's helpful to shift some of the cognitive load elsewhere—an idea that's sometimes referred to as **distributed cognition** or **distributed intelligence** (e.g., Pea, 1993; Salomon, 1993; E. R. Smith & Conrey, 2009).

One way to "distribute" the cognitive load is to use physical objects—for instance, by writing parts of a problem on paper or using a calculator to carry out multistep computations. A second way is to organize and interpret the many concrete facts of a situation—the "raw data," as it were—using concepts, principles, strategies, and other cognitive tools that one's cultural group has developed to address common problems. For example, we might use a *calendar* to keep track of upcoming appointments and other commitments, or we might draw a *line graph* to see if a particular region's average annual rainfall has substantially increased or decreased over the past few decades.

Still a third way to distribute the cognitive load is to share it with other individuals. When learners spread a challenging task or problem across many minds, they can draw on multiple knowledge bases and ideas. For example, we might convene a group of people to brainstorm possible solutions to a local, national, or international problem. Furthermore, in virtually any social group, different people gain expertise in different topics—some become medical doctors, others become engineers, and so on—thereby distributing the group's collective knowledge base.

- *Learners sometimes learn more effectively when they collaborate with others to co-construct meaning.* We've just mentioned how learners can reduce their own cognitive burden, in part, by sharing a task or problem with others. An additional advantage of multilearner collaboration is that, as a group, learners can often make better sense of a situation than they might do on their own. For example, think about times when you've worked cooperatively with classmates to make sense of confusing academic material. Perhaps by sharing various possible interpretations, your group jointly constructed a better understanding of the material than any one of you could have constructed on your own. Unlike individually constructed knowledge, which might differ considerably from one individual to another, socially constructed knowledge is shared by two or more people simultaneously. A perspective known as social constructivism focuses on such collective efforts to impose meaning on the world.

Joint meaning-making doesn't necessarily have to occur in a single learning session, however. In some cases it proceeds gradually over the course of several days or weeks—or even over the course of many decades or centuries. For example, such academic disciplines as mathematics, science, history, economics, and psychology have evolved as the result of long-term collaborations among many individuals. Through these disciplines, people have developed concepts (e.g., *pi* [π], *molecule,* and *revolution*) and principles (e.g., *Pythagorean theorem, supply–and–demand,* and the *limited capacity of working memory*) to simplify, organize, and explain certain aspects of the world or its inhabitants. Literature, music, and the fine arts help us impose meaning on the world as well—for instance, by trying to portray the thoughts and feelings that characterize human experience. Here we see one very critical role that *culture* plays in knowledge construction: To the extent that different groups of people use different concepts and principles to explain their physical experiences and to the extent that they have unique bodies of literature, music, and art to capture their psychological experiences, they'll inevitably see the world in diverse ways.

- *With the help and guidance of more knowledgeable individuals, learners benefit from the accumulated wisdom of their cultural group.* Through its ongoing co-construction of meanings and development of new tools and strategies, any long-standing social group becomes increasingly effective and efficient in tackling challenging tasks and problems. As the group gains new members—often through the birth of new generations—it maintains its effectiveness and efficiency by indoctrinating the new members into its typical ways of interpreting and responding to various situations. Contextual perspectives that emphasize the role of society and culture in promoting learning and development (including Vygotsky's early theory of cognitive development) are collectively known as sociocultural theory.

  In virtually any culture, adults and other more experienced individuals continually help growing children make sense of and respond to new situations in ways the culture deems to be appropriate and productive. In other words, adults *mediate* new situations for children. Over time, children gradually internalize adults' ways of interpreting and addressing day-to-day events until they themselves become the experts who guide future generations.

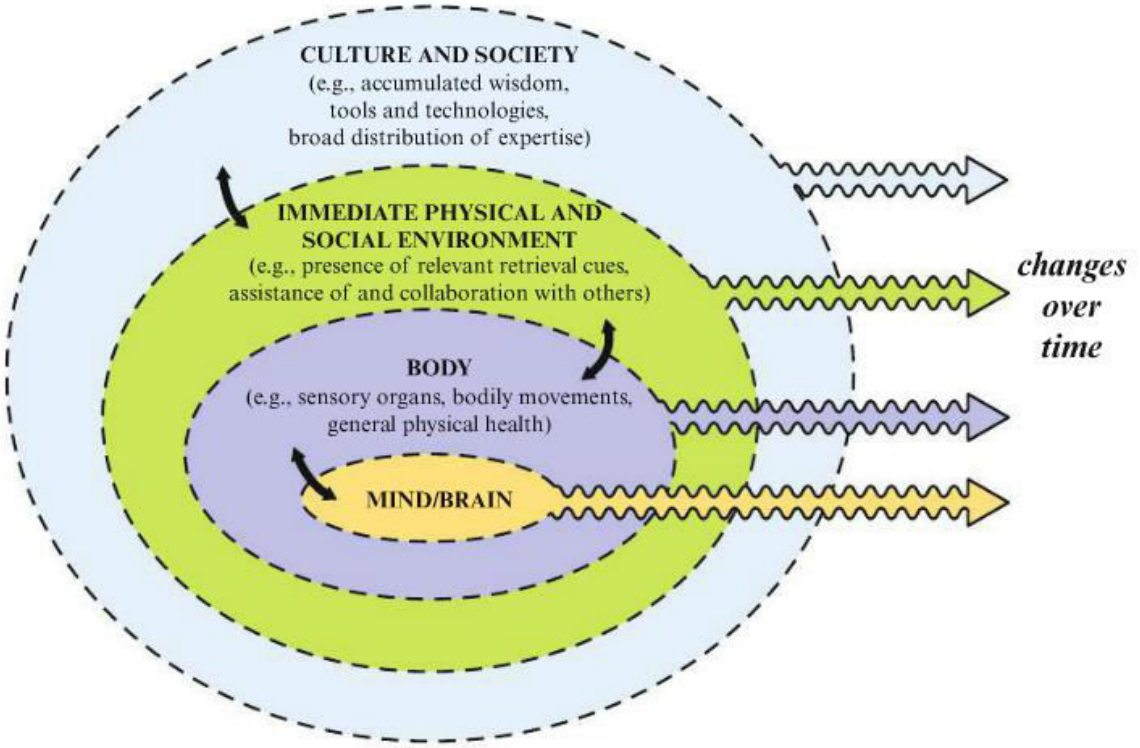
A sociocultural perspective can help us understand Jacob's and Howard's differing interpretations of the school prayer issue in the opening case study. Although both boys had grown up in the United States—and, in fact, in the same part of the country—their parents and schools had probably passed along somewhat different ways of looking at religion and its role in human society. For Jacob, prayer and other Christian traditions provided essential foundations for people's overall well-being, whereas for Howard, legitimate religious beliefs and practices might take a wide variety of forms.

Table 8.1 summarizes the five assumptions, along with some of their implications for instruction. Taken together, the assumptions involve three general layers of context. In particular, people think and learn within the contexts of (1) their physical bodies, (2) their immediate physical and social environments, and (3) the broader cultures and societies in which they live (see Figure 8.1). Keep in mind, however, that the three layers of context *interact and influence one another,* as reflected in the two-way arrows in the figure. Furthermore, all of them *change over time*—for instance, the body's physical capabilities change, access to helpful resources and social collaborators changes, and new technological innovations are becoming increasingly available.

Our focus in the rest of the chapter will be on Layers 2 and 3—more specifically, on how thinking and learning are influenced by learners' immediate social environments and broader culture and society, as well as by the various tools and knowledge bases that culture and society have created to enhance human performance. As you may realize, our discussions of these layers have been heavily influenced by the various layers and systems that Urie Bronfenbrenner has described in his bioecological systems theory.

As we look at various environmental influences on what learners know, think, and can do, however, we mustn't throw our knowledge of learners' internal cognitive processes out the window. Instead, we must continually remember that contextual factors work *in conjunction with*

FIGURE 8.1 The multiple contexts that influence thinking and learning.



learners' internal cognitive processes—for instance, processes related to long-term memory storage and retrieval, metacognition, and problem solving (e.g., Kirsh, 2009; Sawyer & Greeno, 2009; Zusho & Clayton, 2011).

Social Interactions as Contexts

Certainly people sometimes learn new things on their own, perhaps by experimenting with the physical objects around them or perhaps simply by thinking and *re*thinking about things they've previously observed. Yet most human learning is in one way or another a very social enterprise, involving interaction with more advanced individuals, with equal-ability peers, or both.

INTERACTIONS WITH MORE ADVANCED INDIVIDUALS

Young learners are most likely to construct a productive understanding of the world when adults and other advanced individuals share with them the many concepts, principles, theories, and other cognitive tools that society has developed to explain the physical and psychological aspects of human experience (Driver, 1995; Sweller, Kirschner, & Clark, 2007; Vygotsky, 1934/1986). For example, children can learn a great deal about various biological species and fragile ecosystems—and are likely to acquire positive attitudes toward science—when firsthand observations in class or on field trips are accompanied by scientific explanations of the phenomena at hand (e.g., Patrick, Mantzicopoulos, & Samarapungavan, 2009; Zaragoza & Fraser, 2008). Any explanation that helps learners relate what they're observing to particular concepts, principles, or theories is a **mediated learning experience**.

Adults and other advanced individuals help young learners in another important way as well: They introduce new cognitive and metacognitive strategies and guide learners in how to use these strategies, perhaps in a group instructional setting or perhaps in a one-on-one apprenticeship. For instance, in the elementary grades a teacher and students might co-construct a timeline that organizes information about different modes of transportation over the course of human history (Brophy, Alleman, & Knighton, 2009); Figure 8.2 is an example of such a co-constructed

timeline. In the secondary grades a teacher and students might collaboratively create two-dimensional charts to help them compare and contrast what they're learning about the topography, climate, and economic resources of various countries or geographic regions. Through joint discussions and use of strategies—typically with considerable adult guidance and scaffolding at first—learners gradually internalize the strategies and can begin using them independently (A. Collins, 2006; Dennen & Burner, 2008; Rogoff, 1990).

INTERACTIONS WITH PEERS

Learners benefit in somewhat different ways when, in an effort to make sense of new information and experiences, they share their ideas and perspectives with equal-ability peers:

- They must clarify and organize their thoughts well enough to explain and justify them to others.
- They tend to elaborate on what they've learned—for example, by drawing inferences, generating hypotheses, and formulating questions to be answered.
- They are exposed to the views of others, who may have more accurate understandings or culturally different—and yet equally valid—perspectives.
- They may discover flaws and inconsistencies in their own thinking.
- They can model effective ways of thinking about and studying academic subject matter for one another.
- With the support of their peers, they can gain practice in more sophisticated learning and reasoning skills, which they can eventually begin to use on their own.
- They can also gain practice in the argumentation skills that experts in various disciplines use to advance the frontiers of knowledge—for instance, presenting evidence in support of conclusions and examining the strengths and weaknesses of various explanations.
- They may acquire more advanced *epistemic beliefs*—more sophisticated views of the nature of knowledge and learning. For example, they may begin to realize that genuine understanding involves acquiring an integrated set of ideas about a topic and that such knowledge is likely to evolve gradually over time. (Andriessen, 2006; Bendixen & Rule, 2004; Chinn, 2006; Hatano & Inagaki, 2003; K. Hogan, Nastasi, & Pressley, 2000; D. W. Johnson & Johnson, 2009b; A. King, 1999; Kuhn, 2015; Kuhn & Crowell, 2011; P. K. Murphy, Wilkinson, & Soter, 2011; Nussbaum, 2008; Reznitskaya & Gregory, 2013; B. B. Schwarz, Neuman, & Biezuner, 2000; Sinatra & Pintrich, 2003; C. L. Smith, 2007; Vygotsky, 1978; Wentzel & Watkins, 2011)

Peer-group discussions about academic subject matter have social and motivational benefits as well as cognitive ones. Discussing a topic with classmates can help students acquire more effective interpersonal skills (Certo, 2011; Y. Li et al., 2007; N. M. Webb & Farivar, 1994). It can also have an energizing effect on students and instill a genuine desire to understand a topic better (Hacker & Bol, 2004; P. K. Murphy & Mason, 2006). Controversial topics can be especially motivating for them, provided that they can effectively resolve their differences without alienating one another (Chinn, 2006). Clearly, then, students have a great deal to gain from conversing with one another regularly about classroom subject matter.

CREATING A COMMUNITY OF LEARNERS

With the benefits of student dialogue in mind and with a goal of promoting social co-construction of meaning, some psychologists and educators have suggested that we create **communities of learners**, classes in which teachers and students collaborate to build a body of knowledge about a topic and help one another learn about it. A class that operates as a community of learners is likely to have certain characteristics:

- All students are active participants in classroom activities.
- The primary goal is to acquire a body of knowledge on a specific topic, with students contributing to and building on one another's efforts and, typically, creating one or more products representing that knowledge (e.g., a theory, oral presentation, or web page).
- Students draw on many resources—books, magazines, the Internet, and one another—in their efforts to learn about the topic.
- Discussion and collaboration among two or more students occur regularly and play key roles in learning.
- Diversity in students' interests and rates of progress is expected and respected.
- Students and teacher coordinate their efforts in helping one another learn; no one has exclusive responsibility for teaching others.
- Everyone is a potential resource for others; different individuals are likely to serve as resources on different occasions, depending on the topics and tasks at hand. In some cases, individual students focus on particular topics and become local experts on them. Occasionally people outside the classroom share their expertise as well.
- The teacher provides some guidance and direction for classroom activities, but students also contribute guidance and direction.
- Mechanisms are in place through which students can share what they've learned with others.
- Constructive questioning and critiquing of one another's work is commonplace.
- The process of learning is emphasized as much as—and sometimes more than—the finished product(s). (Bielaczyc & Collins, 2006; A. L. Brown & Campione, 1994; Campione, Shapiro, & Brown, 1995; A. Collins, 2006; R. A. Engle, 2006; Rogoff, Matusov, & White, 1996; Scardamalia & Bereiter, 2006; Wells, 2011)

In one example of how a community of learners can be structured (A. L. Brown & Campione, 1994), students are divided into small groups to study different subtopics falling under a general theme; for instance, subtopics for the theme *changing populations* might be *extinct, endangered, artificial, assisted,* and *urbanized.* Each group conducts research and prepares teaching materials related to its subtopic. The class then reassembles into new groups that include at least one representative from each of the previous groups. Within these new groups, the students teach one another what they've learned. Such an approach, in which different students master different topics and then share their knowledge with classmates, is sometimes called the jigsaw technique.

Another approach is to use a computer network to promote a community of learners (Bereiter & Scardamalia, 2006; G. Stahl, Koschmann, & Suthers, 2006; J. Zhang, Scardamalia, Reeve, & Messina, 2009). In this electronic environment, students create a variety of documents—perhaps brief notes, lengthier reports, problem solutions, diagrams, or short stories—and post their work as computer files that their classmates can read, react to, and possibly modify or build on. Students also interact in an ongoing computer-based chat room in which they present questions or issues to which their classmates respond. For example, students might jointly wrestle with the puzzling fact that heat melts some solids but burns others, or they might critique various theories about how human beings first migrated to and then spread throughout North and South America (e.g., Hewitt, Brett, Scardamalia, Frecker, & Webb, 1995; Hewitt & Scardamalia, 1998).

Working in communities of learners can give students a sense of the strategies that scientists and other scholars use to advance the frontiers of knowledge: They conduct individual and collaborative research, share ideas, and build on and critique one another's findings and conclusions. And in fact, participating in such communities appears to promote fairly complex thinking and knowledge-building processes, often for extended time periods (A. L. Brown & Campione, 1994, 1996; R. A. Engle, 2006; R. A. Engle & Conant, 2002; Scardamalia & Bereiter, 2006). Participating in a community of learners is also highly motivating for students, who may insist on going to school even when they're sick and may express regret when the school year ends (Rogoff, 1994; Turkanis, 2001).

In addition to the cognitive and motivational benefits, working in a community of learners can foster effective peer relationships and social skills. It can also help create a *sense of community* in the classroom—a sense that teachers and students have shared goals, are mutually respectful and supportive of one another's efforts, and believe that everyone makes an important contribution to classroom learning.

A community of learners can be especially useful when we have a diverse student population (Kincheloe, 2009; Ladson-Billings, 1995b; Rothstein-Fisch & Trumbull, 2008). Such a community values the contributions of all students, using everyone's individual backgrounds, cultural perspectives, and unique abilities to enhance the overall learning and achievement of the class. It also provides a context in which students can form friendships across the lines of ethnicity, gender, socioeconomic status, and disability—friendships that are critical for students' social development and multicultural understandings.

However, we must also note potential weaknesses of communities of learners, as well as of peer-group discussions more generally. Some students may dominate interactions, and others (e.g., English language learners) may participate little or not at all (Walshaw & Anthony, 2008; T. White & Pea, 2011). Furthermore, particularly if what students learn is limited to the knowledge they personally acquire and share with one another, some of them may pass along their biases, misconceptions, and ineffective strategies to their classmates (A. L. Brown & Campione, 1994; Hynd, 1998b; E. R. Smith & Conrey, 2009). Obviously, then, when we conduct classroom discussions or structure our classrooms as communities of learners, we must carefully monitor student interactions to make sure that everyone is meaningfully participating and that students ultimately acquire *accurate* understandings of the topic they're studying.

Cultures as Contexts

Almost any long-standing social group develops some sort of culture, which includes behaviors and beliefs that are passed from old members to new ones, from generation to generation. Culture is a phenomenon that is largely—although not exclusively—unique to the human species (M. Cole & Hatano, 2007). Through its culture a human social group ensures that each new generation acquires and presumably benefits from the wisdom that preceding generations have accumulated. By passing along this collective knowledge base, a cultural group increases the chances that it will survive and thrive over the long run.

Especially in large, complex societies, learners typically have exposure to and involvement in two or more cultural groups simultaneously. For example, most learners in North America are immersed in what is often called *mainstream Western culture,* which encourages literacy, knowledge of various academic disciplines, and, in its 21st-century form, proficiency in digital technologies. Despite its name, mainstream Western culture also pervades many other countries around the world. But many learners are likely to be active participants in other cultures as well, such as those associated with particular ethnic or religious groups.

Some aspects of cultural knowledge are concrete and easily observable. Such is the case when people use paper and pencil, equations, diagrams, or computers to help them analyze data or solve problems. But other aspects of cultural knowledge are so abstract and pervasive that they're taken for granted and easily overlooked as contextual factors affecting learning. For example, consider the concepts *north, south, east,* and *west.* You've probably used these concepts frequently to help you find your way around the countryside or on a map. Despite their seemingly obvious relationship to Mother Earth, these concepts are creations that some cultures—and only some cultures—provide. Culture's influence on learning and thinking is so strong that researchers have observed cultural differences—small, subtle ones, to be sure—in brain organization and functioning (Park & Huang, 2010).

As culturally experienced individuals explain various phenomena to newer members of a cultural group, they must inevitably focus more on certain aspects of the phenomena than on other aspects. In the process of doing so, young learners discover that certain things are especially important to think about and remember, and these things typically reflect the cultural group's perspectives and priorities. For example, when European American mothers recall past events with their children, they often speculate about the thoughts and feelings of the participants. In contrast, Asian mothers are more likely to talk about social norms and expectations, such as how someone might have behaved more appropriately. Such differences are consistent with the priorities and values of these two cultures (MacDonald, Uesiliana, & Hayne, 2000; Mullen & Yi, 1995; Q. Wang & Ross, 2007). As another example, recall once again Jacob's and Howard's differing interpretations of a court case regarding school prayer. People's religious beliefs are often an integral part of their specific cultural environments.

SCHEMAS, SCRIPTS, AND WORLDVIEWS AS ASPECTS OF CULTURE

As cognitive psychologists have suggested, developing learners draw on their experiences to construct schemas and scripts—general understandings of what things are typically like and how common activities typically unfold. Many schemas and scripts are unique to particular cultures. The exercise we present now illustrates this point.

EXPERIENCING FIRSTHAND
THE WAR OF THE GHOSTS

Read the following story *one time only:*

> One night two young men from Egulac went down to the river to hunt seals, and while they were there it became foggy and calm. Then they heard war-cries, and they thought, "Maybe this is a war-party." They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:
>
> "What do you think? We wish to take you along. We are going up the river to make war on the people."
>
> One of the young men said: "I have no arrows."
>
> "Arrows are in the canoe," they said.
>
> "I will not go along. I might be killed. My relatives do not know where I have gone. But you," he said, turning to the other, "may go with them."
>
> So one of the young men went, but the other returned home.
>
> And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water, and they began to fight, and many were killed. But presently the young man heard one of the warriors say, "Quick, let us go home: that Indian has been hit." Now he thought: "Oh, they are ghosts." He did not feel sick, but they said he had been shot.
>
> So the canoes went back to Egulac, and the young man went ashore to his house, and made a fire. And he told everybody and said, "Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick."
>
> He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried.
>
> He was dead. (F. C. Bartlett, 1932, p. 65)

Now cover the story, and write down as much of it as you can remember.

Compare your own rendition of the story with the original. What differences do you notice? Your version is almost certainly the shorter of the two, and you probably left out many details. But did you also find yourself distorting certain parts of the story so that it made more sense to you?

As a Native American ghost story, "The War of the Ghosts" may be inconsistent with some of the schemas and scripts you've acquired, especially if you were raised in a nonNative American culture. In an early study of long-term memory (F. C. Bartlett, 1932), students at England's Cambridge University were asked to read the story twice and then to recall it at various times later on. Students' recollections of the story often included additions and distortions that made the story more consistent with English culture. For example, people in England rarely go "to the river to hunt seals" because seals are saltwater animals and most rivers have fresh water. Students might therefore say that the men went to the river to *fish*. Similarly, the ghostly element of the story didn't fit comfortably with the religious beliefs of most Cambridge students and so was often modified. When one student was asked to recall the story 6 months after he had read it, he provided the following account:

> Four men came down to the water. They were told to get into a boat and to take arms with them. They inquired, "What arms?" and were answered "Arms for battle." When they came to the battle-field they heard a great noise and shouting, and a voice said: "The black man is dead." And he was brought to the place where they were, and laid on the ground. And he foamed at the mouth. (F. C. Bartlett, 1932, pp. 71–72)

Notice how the student's version of the story leaves out many of its more puzzling aspects—puzzling, at least, from his own cultural perspective.

When students from diverse cultural backgrounds come to school with somewhat different schemas and scripts, they may interpret the same classroom materials or activities differently and in some cases may have trouble making sense of a particular lesson or reading assignment (e.g., Lipson, 1983; R. E. Reynolds, Taylor, Steffensen, Shirey, & Anderson, 1982; Steffensen, Joag-Dev, & Anderson, 1979). As teachers, then, we need to find out whether students have the appropriate schemas and scripts to understand whatever topic we're teaching. When students *don't* have such knowledge, we may sometimes need to back up and help them acquire it before we forge ahead with new material.

Learners' schemas and scripts tend to be specific to particular topics. In contrast, their worldviews—their general beliefs and assumptions about reality—can influence their meaning-making in a great many domains (Koltko-Rivera, 2004; Lewandowsky, Oberauer, & Gignac, 2013). Following are examples of assumptions that a worldview might encompass:

- Life and the universe came into being through random acts of nature *or* as part of a divine plan and purpose.
- Objects in nature (rocks, trees, etc.) have some degree of consciousness *or* are incapable of conscious thought.
- Human beings are at the mercy of the forces of nature *or* should strive to master the forces of nature *or* must learn to live in harmony with nature.
- People are most likely to enhance their well-being by relying on scientific principles and logical reasoning processes *or* by seeking guidance and support from sources beyond the realm of scientific and logical thought.
- People's successes and failures in life are the result of their own actions *or* divine intervention *or* fate *or* random occurrences.
- The human world is fair and just—good deeds ultimately bring rewards, and misdeeds are eventually punished—*or* is not necessarily fair and just. (M. Cole & Hatano, 2007; E. M. Evans, Rosengren, Lane, & Price, 2012; Furnham, 2003; Gifford, 2011; Keil & Newman, 2008; Koltko-Rivera, 2004; Medin, 2005)

To a considerable degree, such beliefs and assumptions are culturally transmitted, with different cultures communicating somewhat different beliefs and assumptions either explicitly through their words or implicitly through their actions (Berti, Toneatti, & Rosati, 2010; M. Cole & Hatano, 2007; Kitayama, 2002; Losh, 2003).

Worldviews are often such an integral part of everyday thinking that people take them for granted and usually aren't consciously aware of them. In many cases, then, worldviews encompass *implicit knowledge* rather than explicit knowledge. Nevertheless, they influence learners' interpretations of current events and classroom subject matter. For example, if students believe that the world and its inhabitants are guided and protected by an omniscient and benevolent Greater Being, they're less likely to believe that global climate change is real or poses a significant threat to human society (Feinberg & Willer, 2011). And if students' culture consistently emphasizes the importance of accepting and living in harmony with nature as it is, they might struggle with a science curriculum that explores how human beings might manipulate and gain control over natural events (Atran, Medin, & Ross, 2005; Medin, 2005).

In some cases, academic subject matter may conflict with students' most core beliefs—and ultimately with the very essence of who they are as individuals. For example, students who strongly believe in the divine creation of humankind may readily dismiss any suggestion that the human race has evolved from more primitive species (E. M. Evans et al., 2012; Southerland & Sinatra, 2003). And students whose cultures view certain historical battles as involving good guys triumphing over bad guys—or vice versa—may disregard more balanced perspectives in which each side had legitimate needs and concerns (K. Jacoby, 2008; Levstik, 2011; Porat, 2004). Hence, students' worldviews can sometimes interfere with their ability to undergo legitimate conceptual change. Under such circumstances a more achievable goal may be to help students *understand* (rather than *accept*) academic scholars' explanations and lines of reasoning (Feinberg & Willer, 2011; Southerland & Sinatra, 2003).

As teachers, we must remember that we, too, have certain worldviews—often implicit, below-the-surface ones—that influence what and how we think about our physical and social worlds. For example, we may place greater value on the importance of objective scientific investigations as a source of new knowledge than some of our students do (Thanukos & Scotchmoor, 2012). And many of us are apt to think that the practices of certain cultural groups are in some way inferior to those of mainstream Western culture (Banks et al., 2005). Difficult as it might sometimes be to do so, we must continually reflect on our own cultural beliefs and acknowledge that they influence what and how we teach—sometimes for the better but sometimes to the detriment of our students' learning and development.

COMMUNITIES OF PRACTICE AS ASPECTS OF CULTURE

Any cultural group passes along not only certain ways of interpreting the world but also certain ways of doing things. In other words, different cultures teach somewhat different kinds of *procedural knowledge.* Some procedural knowledge is task- or topic-specific and is conveyed directly and explicitly—for example, "Here's how to write a cursive *A*," and "Let me show you how to do long division." But cultures typically also pass along a good deal of procedural knowledge within the context of communities of practice—groups of people who share common interests and goals and regularly interact and coordinate their efforts in pursuit of those interests and goals (Lave, 1991; Nolen, 2011; Sawyer & Greeno, 2009; Wenger, 1998). Communities of practice tend to adhere to certain standards for action and interaction—standards that are often unwritten understandings rather than explicitly stated rules. For example, in the adult world of mainstream Western culture, people in various professions—medicine, law, scientific research, and so on—tend to communicate regularly with one another and to support one another in particular ways. In most cases, new members of a community of practice learn the acceptable ways of doing things primarily by actively *participating* in the group. Often a learner begins by participating only at the fringe of the group, perhaps by doing menial chores or by assisting or apprenticing with a more experienced group member. In other words, a novice is gradually introduced to the ways of the group through legitimate peripheral participation (Lave & Wenger, 1991). Participation is *legitimate* in the sense that the novice contributes in genuine, authentic ways to the group's overall effort. It's *peripheral* in that it involves only small tasks at the outer edge, or periphery, of the action.

Communities of practice are hardly limited to adult professional groups. For instance, volunteer organizations (e.g., Habitat for Humanity, the American Red Cross) and organized youth groups (e.g., Boy Scouts and Girl Scouts) are essentially communities of practice as well. Schools, too, are communities of practice, in that they have certain prescribed ways of doing things in

order to accomplish particular goals—for example, following schedules, completing assignments, and meeting deadlines.

We teachers must certainly help students learn the expectations of their educational community. But in addition, we can help students learn the ways of various adult professional communities, and of the adult world more generally, by having students actually participate in adult activities—perhaps by encouraging part-time internships with local businesses or collaborative efforts with public service organizations. Initially their participation might involve only easy tasks that are closely guided and supported, but as students gain more knowledge and skills they should also gain more responsibility and independence.

MyEdLab **Self-Check 8.3**

MyEdLab **Application Exercise 8.2.** In this exercise, you can practice reconciling students' personal cultural beliefs and practices with the academic and behavioral expectations of classrooms in mainstream Western culture.

Society and Technology as Contexts

A concept related to culture, but also somewhat distinct from it, is society: a very large, enduring social group that has fairly explicit social and economic structures, as well as collective institutions and activities. For instance, virtually any nation is a society, in that it has a government that regulates some of its activities, a set of laws identifying permissible and unacceptable behaviors, a monetary system that allows members to exchange goods and services, and well-established means of communication among its members.

A society influences its members' learning in a variety of ways, including through the resources it provides, the activities it supports, and the general messages it communicates (e.g., Bronfenbrenner, 2005; Gauvain & Munroe, 2009). For example, a society's infrastructure—such as its roads, power plants, and telephone and cable lines—enables the movement of people and goods over great distances and regular collaboration among its residents. Various media (newspapers, television, the Internet, etc.) convey information, ideas, opinions, and messages (often subtle ones) about desired behaviors and group stereotypes. And schools provide formal structures through which children and adults alike acquire knowledge and skills that will presumably enhance their personal and professional success.

One noteworthy aspect of any society is its distributed knowledge: Different people have expertise in different topics, and so society members must rely on one another in order to maximize both their individual success and the success of the overall group. To be truly effective participants in society, then, people must learn how to seek out the expertise they may occasionally need to (a) tackle challenging problems and (b) distinguish between true experts, on the one hand, and individuals who only *claim* to be experts, on the other (Bromme, Kienhues, & Porsch, 2010).

As teachers, virtually anything we do with students should in one way or another enhance their long-term success in adult society. But here we focus on two particular topics about which educational psychologists have had a great deal to say in recent years: authentic activities and technological innovations.

AUTHENTIC ACTIVITIES

In industrialized societies, children are largely separated from the adult workplace, and thus they have little exposure to the kinds of tasks they'll eventually need to perform when they themselves reach adulthood (Rogoff, 2003). Accordingly, many learning theorists recommend that teachers make frequent use of authentic activities—activities similar or identical to those that students will eventually encounter in the outside world (e.g., Barab & Dodge, 2008; Edelson & Reiser, 2006; Greeno, Collins, & Resnick, 1996). Such activities can have several benefits. For one thing, by working in naturalistic contexts, using the physical and social resources that such contexts offer (e.g., tools, other people), students should be able to accomplish more than they would accomplish in relatively artificial and simplistic classroom tasks. Second, complex authentic tasks are likely to promote meaningful learning rather than rote memorization of new information and

procedures. Finally, because they resemble real-world tasks and problems, authentic activities should help students make mental connections between school subject matter and out-of-school situations, and these connections should help students retrieve and apply—that is, *transfer*—what they've learned to new settings and problems.

Many research studies have confirmed the effectiveness of authentic activities (e.g., Gijbels, Dochy, Van den Bossche, & Segers, 2005; Hung, Jonassen, & Liu, 2008). For example, students' writing skills may show greater improvement in both quality and quantity when, instead of completing traditional workbook writing exercises, they write stories, essays, and letters to real people (E. H. Hiebert & Fisher, 1992). Students gain a more complete understanding of how to use and interpret maps when, instead of answering workbook questions about maps, they construct their *own* maps (M. Gregg & Leinhardt, 1994a). And students are more likely to check their solutions to math problems—in particular, to make sure their solutions make logical sense—when they use math for real-life tasks (Cognition and Technology Group at Vanderbilt, 1993; De Corte, Greer, & Verschaffel, 1996).

Authentic activities can also be highly motivating for students (M. Barnett, 2005; Marks, 2000; Wirkala & Kuhn, 2011). As an example, consider one high school student's recollection of a ninth-grade moon-tracking activity:

> It was the first time I can remember in school doing something that wasn't in the textbook … like we were real scientists or something. We had to keep data sheets, measure the time and angle of the moonrise every day for a month. It drove my mom nuts because sometimes we'd be eating dinner, and I'd look at my watch and race out the door! We had to measure the river near us to see how it was affected by the moon. . . I went down to the river more than I have in my whole life, I think. Then we had to do the calculations, that was another step, and we had to chart our findings. The test was to analyze your findings and tell what they meant about the relationship of the tides and the moon… . I felt that I did something real, and I could see the benefit of it. (Wasley, Hampel, & Clark, 1997, pp. 117–118)

By placing classroom activities in real-world contexts, we help students discover the reasons why they're learning academic subject matter. Accordingly, authentic activities may be especially valuable in working with students who are at risk for academic failure (L. W. Anderson & Pellicer, 1998; Christenson & Thurlow, 2004; Tate, 1995).

Authentic activities can be developed for virtually any area of the curriculum. For example, we might ask students to do the following:

- Write an editorial
- Participate in a debate
- Design an electrical circuit
- Converse in a foreign language
- Make a video
- Perform in a concert
- Plan a personal budget
- Create a classroom website

In some instances authentic activities take the form of problem-based learning or project-based learning, in which students acquire new knowledge and skills as they work on complex problems or projects similar to those they might find in the outside world (Hmelo-Silver, 2004, 2006; Krajcik & Blumenfeld, 2006; Wirkala & Kuhn, 2011). Occasionally authentic activities may also involve service learning—that is, they involve projects that directly or indirectly enhance the quality of life in the outside community (W.-M. Roth, 2011; Thapa, Cohen, Guffey, & Higgins-D'Alessandro, 2013). To be effective in enhancing students' learning—and to be sources of pleasure and success rather than sources of frustration and failure—most complex authentic activities require considerable teacher guidance and support (Hmelo-Silver, Duncan, & Chinn, 2007; Mergendoller, Markham, Ravitz, & Larmer, 2006).

Authentic activities are possibly most beneficial when they promote complex thinking skills—for instance, synthesizing information, forming and testing hypotheses, or solving problems—and when their final outcomes are multifaceted and somewhat unpredictable (Newmann & Wehlage, 1993; S. G. Paris & Turner, 1994). Nevertheless, they should be sufficiently simple that they don't impose an unmanageable cognitive load—in other words, they shouldn't be so complex that students find them overwhelming (Kester, Paas, & van Merriënboer, 2010; Plass, Kalyuga, & Leutner, 2010). The Into the Classroom feature "Conducting Authentic Activities" offers several strategies that researchers and experienced educators have found to be effective.

TECHNOLOGICAL INNOVATIONS

Strictly speaking, *technology* includes any humanmade application of scientific knowledge for a practical purpose. But the focus here will be on *digital technologies*—those that enable us to electronically store, manipulate, and transmit information. (The word *digital* refers to the fact that the information is stored in the form of many, many 0s and 1s, collectively known as *bits*.) Computer hardware and software, cell phones, video cameras, video game systems, and the Internet are all examples of digital technologies.

As these technologies have become more widely available and affordable, they've also become more pervasive in modern-day societies. For example, although precise statistics on cell phone usage are virtually impossible to obtain, the majority of middle school and high school students in North America and western Europe appear to have their own cell phones, and many of them are proficient in using their phones not only to make calls but also to send text messages, take and send photographs, and post opinions and photos on social networking sites such as Facebook and Instagram. For most adolescents, the primary motive for using cell phones and other new technologies is to initiate and maintain social relationships, especially with peers (Ito et al., 2009; Valkenburg & Peter, 2009; Warschauer, 2011).

Recent technological innovations have increasingly enabled people around the world to access that *distributed knowledge* of which we spoke earlier. Gone are the days when quick access to important information required people to either (a) effectively store it in their own long-term memories or on personal bookshelves or (b) travel to a public library or other physical source of

knowledge about a particular topic. Instead, people can gain needed information about almost any subject area—and sometimes they gain *mis*information—with a few simple keystrokes on an Internet search engine such as Google, Bing, or Yahoo! The overall learning environment of the early 21st century is indeed a very different one from that of the mid-20th century.

TECHNOLOGY IN LEARNING AND INSTRUCTION

When learning takes place in an electronic environment, it's sometimes called e-learning. But regardless of what we call it, the many technologies available in 21st-century societies can enhance learning in numerous ways:

- *Instruction can seamlessly integrate several media and multiple pedagogical strategies.* For example, instructional software programs often integrate written text with graphics, videos, simulations, exercises, and assessments. And *interactive smartboards*—large wall-mounted displays connected to a computer and projector—are increasingly replacing traditional chalkboards and whiteboards. Not only can these boards display the contents of a computer screen—perhaps a video, a set of instructions, or an Internet website—but in addition, class members can electronically write and draw on them, with the products being transmitted to and saved on the computer.

  Even many textbooks (including this one!) take a digital form these days. Digital textbooks might include not only traditional text and graphics but also videos, audio recordings, practice exercises, and links to dictionary and glossary entries. Students can electronically "search" for particular words or concepts, highlight sections of particular interest or importance, and add personal notes related to the content.
- *Instruction itself can be delivered from afar.* For example, students can participate in classroom activities when they must be absent from school for extended periods, perhaps because of a chronic illness or significant injury. Also, students can take courses that aren't available in their local school districts—perhaps Advanced Placement high school courses or college coursework appropriate for their ability levels. Collectively, such forms of instruction are known as distance learning.

- *Instruction can more easily be individualized to accommodate students' unique needs.* For example, Internet-based research projects allow students to pursue topics of personal interest in considerable depth. And software programs known as intelligent tutoring systems help students master knowledge and skills in various content domains—for instance, in reading, math, and science—by giving them ongoing, individually tailored guidance, hints, and feedback as they study new concepts and procedures. When well designed, these software programs can be as effective as one-on-one human tutors in helping students learn (Ma, Adesope, Nesbit, & Liu, 2014; Steenbergen-Hu & Cooper, 2013; VanLehn, 2011; W. Ward et al., 2013).
- *Learners can manipulate data in a variety of ways while also keeping their cognitive load within reasonable limits.* As teachers, we must remember that complex thinking tasks can impose a significant burden on working memory. In line with the notion of *distributed cognition,* digital technologies can carry some of the cognitive burden and free up some working memory capacity for problem solving and creativity. For example, students can use computer spreadsheets and graphing software to explore and examine the effects of different values of x in an algebraic equation. And they can use concept-mapping software such as Kidspiration or MindMapper Jr. for Kids—sometimes called *mind-mapping* programs—to try out various ways of organizing and interrelating new material. Ideally, technology can provide an electronic "playground" in which students can experiment with and expand on ideas (J. A. Langer, 2011; Spiro & DeSchryver, 2009).
- *Diverse bodies of knowledge are within easy reach, especially on the Internet, and can be searched on an as-needed basis.* Most schools in mainstream Western culture have computers with Internet connections located either in individual classrooms or in separate computer resource rooms. Some schools also provide laptops or computer tablets (e.g., iPads) that students can use as individuals or in small groups. Outside of school, many students can find computers at libraries and other public places. And as their cell phones increasingly become multifunction *smartphones,* they can access the Internet wirelessly (i.e., through *wifi*) at libraries, coffee shops, and other wireless "hotspots."

- *Teachers and learners can easily communicate and collaborate with one another.* Technology can certainly enhance communication and collaboration within a single classroom. For example, course management systems such as Blackboard and Moodle provide means through which teachers can post materials and assignments, students can upload their work for feedback or evaluation, and all class members can regularly interact through classroom discussion boards or chat rooms. Another good resource is Google Apps for Education, through which schools can create a separate email account for every student, post school and classroom calendars with scheduled activities and due dates, and upload documents to which teachers and students alike can contribute. In addition, teachers and their students can create class-specific *wikis,* websites on which individual class members can add to, edit, or rearrange material previously contributed by other members. Popular wiki-creation websites include wikispaces.com, web.com, and wix.com.

  Thanks to the Internet, individual students or entire classes can also communicate and collaborate with students or classes in other locations—even in other nations (e.g., see iearn.org). One good vehicle for doing so is Skype (skype.com), through which people at two different locations can both see and hear each other on any computer, tablet, or smartphone that has a built-in video camera and microphone.

  Finally, teachers are increasingly communicating and collaborating with *one another* via the Internet. For example, many teachers share lesson plans and other instructional strategies they've found to be effective (e.g., see www.tappedin.org or www.oercommons.org). Some teachers have even written electronic textbooks that other teachers can use and modify for their own purposes (e.g., see ck12.org).
- *Technology offers many means of providing authentic activities.* One strategy mentioned earlier—creating a class wiki—can be a highly authentic activity for students. Other possibilities include creating class newsletters, videos, or video games (e.g., see sploder.com, arisgames.org, or yoyogames.com/studio). Also, students can post their poems and short stories online for people elsewhere to read and critique. And through well-designed simulations, they can design and carry out virtual scientific "experiments" to test their theories about cause-and-effect relationships in the physical world.

- *Some technology-based instructional strategies effectively blur the lines between "work" and "play."* Well-designed technology-based instruction is highly interactive and can keep students motivated and engaged for lengthy periods. Some educators and software developers are now developing challenging video games that electronically immerse students in simulated environments in which they act as, say, tribal chiefs in 4000 BC, 20th-century urban planners, or farmers (e.g., look for online descriptions of *Civilization, SimCity,* and *Harvest Moon,* respectively). In the process of playing these games, students can learn a great deal about history, geography, and other academic content domains (Squire, 2011; Tobias & Fletcher, 2012; Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013). Also, students can acquire athletic skills and develop physical fitness through hardware and software in which they virtually engage in such activities as dancing, tennis, and baseball—an approach that's sometimes called *exergaming* (Shayne, Fogel, Miltenberger, & Koehler, 2012).

As we incorporate digital technologies and the Internet into instruction, however, we must give students the guidance they need to use these things effectively. Following are general suggestions:

- Don't assume that instruction is better only because it involves technology. Instead, make sure that the technological tools you use *enhance* students' thinking and learning in some way.
- Remember that some students may have had little or no experience with technology. As needed, teach them any basic skills they haven't yet mastered—perhaps how to send an email message; how to conduct a simple Internet search; or how to create, edit, and save a word processing document.
- Structure activities sufficiently that students aren't easily distracted by irrelevant information and activities (e.g., clicking on unproductive links or Internet websites, or going to personal Facebook pages).

- Teach and insist on appropriate social etiquette for cross-communication, and monitor students' entries for content; especially be on the lookout for bullying and other antisocial messages. (Arnesen, Elstad, Christophersen, & Vavik, 2014; Bellanca & Stirling, 2011; N. Carr, 2011; R. E. Clark, Yates, Early, & Moulton, 2009; Rivers, Chesney, & Coyne, 2011; Warschauer, 2011)

In addition, we must remember that use of the Internet requires literacy skills far beyond those necessary for more traditional reading and writing tasks, as we'll discover in an upcoming section on technological literacy.

MyEdLab **Self-Check 8.5**

Academic Content Domains as Contexts

In the early millennia of human civilization, cultures and societies focused largely on teaching children knowledge and skills related to basic survival (hunting, growing crops, cooking, etc.), and experts in such areas as woodworking, metalwork, and medicine often taught their knowledge to new generations through one-on-one apprenticeships. But as cultural groups developed writing systems and constructed increasingly complex understandings of their physical, biological, and social worlds, they began to establish formal schools that could more efficiently pass their cultural creations along to future generations. One way in which schools made the ever-expanding knowledge base more manageable for instruction was to subdivide it into various academic disciplines, such as reading, writing, mathematics, science, history, and geography.

To some degree, different academic content domains require different thinking skills. For example, effective reading requires automatic retrieval of the meanings of thousands of words in one's language, whereas mathematical problem solving requires precisely thinking about quantities and flexibly manipulating symbols that represent them. Furthermore, various subject areas may depend more or less heavily on different parts of the brain (Dehaene, 2007; Katzir & Paré-Blagoev, 2006; Norton, Kovelman, & Pettito, 2007; Plumert & Spencer, 2007; Posner & Rothbart, 2007).

In a very real way, then, different content domains are additional *contexts* in which students learn, and strategies for effectively teaching the subject matter can vary significantly from one domain to another. In upcoming sections we'll consider four general content domains: literacy, mathematics, science, and social studies. By no means do these topics cover all of the academic curriculum; for example, physical education, music, and the visual and performing arts are also disciplines in their own rights and enhance children's development and general well-being in many ways (e.g., J. H. Davis, 2008).

In discussing the four domains separately, we authors don't mean to imply that each domain should be consistently taught in isolation from the others. On the contrary, instruction is often more effective when it simultaneously incorporates two or more domains—perhaps teaching reading in conjunction with science or teaching writing in conjunction with history (e.g., Martínez, Bannan-Ritland, Kitsantas, & Baek, 2008; Monte-Sano, 2008). Furthermore, several general principles of learning apply to *all* domains:

- Learners use the information they receive from various sources to construct their own, unique understandings.
- Learners' interpretations of new information and events are influenced by what they already know and believe about the world.
- With age and development, learners acquire metacognitive strategies and epistemic beliefs that influence their thinking and performance within a domain.
- Learners often gain greater understanding and greater metacognitive sophistication in a domain when they work collaboratively with peers.

LITERACY

The word *literacy* has two distinct meanings. In its narrower sense, it refers to one's reading and writing abilities. In its broader sense, it refers to one's general ability to understand and communicate meanings using the various concepts and symbols of a particular community of practice—perhaps that of physicists, musicians, or computer programmers. For now we'll be focusing on the narrower sense of the word: reading and writing. But we must remember that success in virtually any academic discipline requires mastery of its discipline-specific concepts and symbols.

Children's reading and writing skills obviously build on their knowledge of spoken language. But in addition, children must learn the relationships between how words sound and are produced in speech, on the one hand, and how they look and are written on paper, on the other. Children must also master nuances of the written symbol system that have no counterparts in spoken language, such as punctuation marks and appropriate uses of uppercase and lowercase letters.

Through storybook reading and other activities at home, many children—but not all of them—come to school knowing a few things about written language. For example, they may know that spoken language is represented in a consistent fashion in writing, that reading proceeds from left to right and from the top of the page to the bottom, and that each alphabet letter is associated with particular sounds in spoken language. They may be able to write part or all of their own names, and they may recognize logos of popular products and commercial establishments, such as Coke and McDonald's. Taken together, such knowledge and skills—collectively known as emergent literacy—lay a basic foundation for reading and writing (A.W. Gottfried, Schlackman, Gottfried, & Boutin-Martinez, 2015; Serpell, Baker, & Sonnenschein, 2005). And reading and writing, in turn, provide important foundations for learning most other academic disciplines, especially in the middle and secondary school grades (E. Fox & Alexander, 2011; Martínez et al., 2008; C. Shanahan, 2004; H. L. Swanson, 2006).

As a topic of formal instruction, reading is taught primarily in elementary school. Writing instruction continues in secondary school language arts classes. Yet effective reading and writing strategies tend to take somewhat different forms in different academic disciplines. For example, reading a textbook in a math class is quite different from reading a newspaper article in a social studies class (recall Jacob's and Howard's conflicting interpretations of a court decision in the opening case study), and writing a short story is quite different from writing a science lab report. As teachers, then, we should teach reading and writing within the context of a variety of content domains—not only in language arts classes but also in math, science, and social studies classes.

THE NATURE OF SKILLED READING

Reading is a multifaceted process that involves considerable knowledge and abilities:

- *Sound and letter recognition:* A large body of research indicates that phonological awareness—hearing distinct sounds, or *phonemes*, within a spoken word (e.g., detecting the sounds "guh," "ay," and "tuh" in the word *gate*)—is an essential element of successful reading, especially in the beginning stages of learning to read. And, of course, learners must be able to recognize alphabet letters in various fonts and in both uppercase and lowercase forms (Anthony & Francis, 2005; Boscardin, Muthén, Francis, & Baker, 2008; Hulme, Bowyer-Crane, Carroll, Duff, & Snowling, 2012).
- *Word decoding skills:* Readers inevitably encounter words they don't recognize. In such instances they must draw on letter–sound relationships, familiar prefixes and root words, common spelling patterns, and context clues to decipher the words (Goswami, 2007; Nagy, Berninger, & Abbott, 2006; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).
- *Automatic word recognition:* When learners must use their limited working memory capacity to decode and interpret *many* individual words, they have little or no mental "room" left to use in gaining an overall understanding of what they're reading. Ultimately, word recognition must become automatic in two ways: Learners must be able to (a) identify most words in a split second, without having to decode them letter by letter; and (b) immediately retrieve the words' meanings (Curtis, 2004; Klauda & Guthrie, 2008; H. L. Swanson & O'Connor, 2009).
- *Meaning construction:* Effective reading is a constructive process: Good readers go far beyond the words themselves, identifying main ideas, drawing inferences, deriving applications, and so on. Sophisticated readers also find symbolism in works of fiction, evaluate the quality of evidence in persuasive essays, and identify assumptions or philosophical perspectives that underlie editorials. Meaning construction can be especially challenging when learners must integrate what they read from two or more distinct texts, as Jacob and Howard must do in the opening case study (Cromley & Azevedo, 2007; E. Fox & Alexander, 2011; Gaskins, Satlow, & Pressley, 2007; Kintsch, 2009).

- *Metacognitive oversight:* Good readers metacognitively "supervise" their own reading. For example, they set goals regarding what they want to learn, focus attention on parts they deem to be important, and continually self-assess their understanding and memory of what they've read. And ultimately, good readers understand that reading involves actively *making* meaning, rather than mindlessly "absorbing" meaning from the page (Bråten, Britt, Strømsø, & Rouet, 2011; Gaskins et al., 2007; Pressley & Harris, 2006).

It shouldn't surprise you to learn that the amount of knowledge learners already have about a topic enhances their ability to comprehend what they read (Beck, McKeown, Sinatra, & Loxterman, 1991; Britton, Stimson, Stennett, & Gülgöz, 1998). For example, second graders who already know a lot about spiders remember more when they read a passage about spiders, and they can draw inferences more readily than their less knowledgeable classmates (Pearson, Hansen, & Gordon, 1979). Similarly, eighth graders who know more than their peers about a particular period in history can more readily draw inferences from new material about that period (Vidal-Abarca, Martínez, & Gilabert, 2000). Helpful, too, is knowledge about the structures that various types of literature typically follow; for example, the events described in works of fiction usually follow a chronological sequence, and persuasive essays usually begin with a main point and then present evidence to support it (Byrnes, 1996; Cain, Oakhill, & Bryant, 2004; Leon, 2008).

As learners grow older and gain more experience as readers, they become increasingly able to understand what they read, in part because they (a) gain automaticity in word recognition, (b) acquire more effective learning strategies and metacognitive processes, and (c) have a larger knowledge base on which to draw as they read. Table 8.3 lists typical characteristics of readers at different grade levels. Nevertheless, we must keep in mind that students at any single grade level differ widely in their reading skills; for example, some high school students have poor word decoding skills and little ability to make sense of what they read (Curtis, 2004; Felton, 1998; N. Gregg, 2009). As teachers, then, we should nurture students' reading development at *all* grades.

THE NATURE OF SKILLED WRITING

As you might guess, learners who are better readers also tend to be better writers. This correlation is partly due to the fact that general language ability—such as knowledge and effective use of vocabulary and various grammatical structures—provides a foundation for both reading and writing. Furthermore, practice in reading promotes vocabulary development and greater awareness of how words are spelled. And regular reading familiarizes learners with common ways in which fiction and nonfiction texts are structured (De La Paz & McCutchen, 2011; Rayner et al., 2001; T. Shanahan & Tierney, 1990). But effective writing involves additional processes as well:

- *Goal setting:* Good writers determine what they want to accomplish in their writing—perhaps to entertain, describe, report, or persuade—and have a good sense of the audience for whom they're writing (Graham, 2006; Scardamalia & Bereiter, 1986; Sitko, 1998).
- *Identification and organization of relevant knowledge:* Whether they're writing fiction or nonfiction, good writers identify what they already know about a topic and then, if necessary, supplement it with additional research. Typically they also spend a fair amount of time organizing their ideas before they write (Benton, 1997; Berninger, Fuller, & Whitaker, 1996; R. T. Kellogg, 1994).
- *Focus on communication rather than mechanics:* Good writers have typically learned the basic mechanics of writing (handwriting, spelling, punctuation, etc.) to automaticity, thereby leaving "room" in working memory to focus on effectively communicating their intended message (Benton, 1997; Limpo & Alves, 2013). In their initial drafts, skilled writers focus on conveying their ideas in ways that will help readers readily grasp their meaning; for example, they begin with what they think readers are likely to know and systematically lead readers toward better understandings. In other words, good writers engage in knowledge transforming. In contrast, less skilled writers engage in knowledge telling, writing thoughts in the order in which they retrieve them from long-term memory, with little concern for helping readers understand and learn (Bereiter & Scardamalia, 1987; Graham, Harris, & Olinghouse, 2007; McCutchen, 1996). The essays in Figure 8.3 illustrate the difference.

- *Revision:* Good writers almost invariably revise what they've written, often several times. Although they certainly look for problems related to spelling and grammar, they focus on enhancing organization and clarity while keeping in mind the overall goals of their writing (De La Paz & McCutchen, 2011; Fitzgerald, 1992; K. R. Harris, Santangelo, & Graham, 2010).
- *Metacognitive regulation of the overall writing effort:* Throughout the writing process, good writers are metacognitively active: They monitor their progress and the effectiveness of what they've written, addressing questions such as these:
  - Am I achieving my goal(s) for writing this piece?
  - Am I following a logical train of thought?
  - Am I giving examples to illustrate my ideas?
  - Am I supporting my opinions with valid arguments?

  The answers to such questions influence their subsequent courses of action (Hacker, Keener, & Kircher, 2009; K. R. Harris et al., 2010).

The nature and quality of students' writing evolve in many ways throughout the elementary and secondary school years. In the early elementary grades, writing projects typically involve narratives: Students write about their personal experiences and create short, fictional stories. They have a hard time writing for an imagined audience and, as a result, engage almost exclusively in knowledge telling rather than knowledge transforming. And they're still working on basic skills in spelling, punctuation, and grammar—skills that can consume much or all of their working memory capacity (Graham et al., 2007; Hemphill & Snow, 1996; McCutchen, 1996).

In the upper elementary grades, writing mechanics are becoming automatic, enabling students to devote more effort to communicating their thoughts effectively. Furthermore, students begin to think about how their readers might respond to what they've written and so are more apt to proofread and revise their work. At this point, however, they do little planning before they begin to write, and their writing continues to involve more knowledge telling than knowledge transforming (Graham, 2006; R. E. Owens, 2008).

In the secondary grades, students are better able to analyze and synthesize their thoughts as they write, and thus they're more skillful in writing research papers and argumentative essays. At this point, too, although many students continue to engage in knowledge telling, knowledge transforming becomes more common. And students become more metacognitively involved in the writing process, especially when given instruction and guidance in effective metacognitive writing strategies (Graham & Perin, 2007; K. R. Harris et al., 2010; Spivey, 1997).

TECHNOLOGICAL LITERACY

Use of digital technologies and the Internet requires literacy knowledge and skills beyond those involved in traditional paper-based reading and writing tasks, including the following:

- *Use of common functions:* Some functions are essential in using a wide variety of computer applications. For example, learners must know how to "open," "cut," "paste," and "save," and how to search for desired information or locations in a document.
- *Use of device-specific operating systems:* Most learners who have cell phones know such basics as how to make a phone call, send a text message, or add a friend's contact information to an

address book. But to be technologically literate in the 21st century—especially as electronic books (e-books) become increasingly common—learners must also be able to find their way around the various applications of personal computers and tablets.

- *Use of specific computer applications:* For example, word processing software, spreadsheets, and presentation software (e.g., PowerPoint) are now commonplace in many elementary and secondary school classrooms. And various Internet-based communication applications—such as email, chat rooms, discussion boards, and wikis—all involve not only basic reading and writing skills but also application-specific knowledge.
- *Effective search for relevant and credible Internet websites:* Learners must know how to use Internet search engines and identify appropriate keywords to initiate a search. They must be able to determine whether particular Internet websites are relevant or irrelevant to particular tasks and questions. They must critically evaluate each website they find in order to make reasonable judgments about the validity of its content. And they must often pull together what they learn from various sources into an integrated, organized whole.

Perhaps through past experiences with cell phones, video games, or home computers, many students come to school with some of these skills. Yet others don't have the basics—for instance, they may not know how to turn a particular device on and off—and so we must certainly teach them what they don't know. Yet even students who seem to be technologically sophisticated may lack all the cognitive skills they need to *learn* effectively from technology. Learning from Internet websites can be especially problematic for them, for several reasons. First, they may have trouble sorting through the hundreds of sites that an Internet search yields in order to determine which ones are truly relevant to their questions and needs. Second, they may not have the knowledge and skills they need to discriminate between sites that present objective information, on the one hand, and those that convincingly offer biased social or political propaganda, on the other. Third, they may not know how to organize and synthesize the separate bits of information they've found on various sites. Finally, they may not have the self-motivating "stick-to-it-iveness" that lengthy and

occasionally frustrating Internet searches can involve (Afflerbach & Cho, 2010; K. Hartley & Bendixen, 2001; Leu, O'Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009; Manning, Lawless, Goldman, & Braasch, 2011).

Clearly, then, students often need considerable scaffolding as they conduct online research about classroom topics, especially with regard to the *metacognitive* strategies they should use in the process. Following are a few suggestions:

- Use a database or search engine that restricts the websites to which students have access (e.g., EBSCO Information Services's "Searchasaurus" search engine).
- Provide specific questions students should try to answer as they read.
- Also provide questions students should consider in evaluating the credibility of a website's content (e.g., "Does a reputable organization sponsor the website?" "What evidence supports this point of view?").
- Give students structured practice in comparing and contrasting websites that present diverse and possibly contradictory perspectives.
- Ask students to write summaries of what they've learned from multiple websites, perhaps in collaboration with peers. (Afflerbach & Cho, 2010; P. A. Alexander & the Disciplined Reading and Learning Research Laboratory, 2012; Bromme et al., 2010; Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Manning et al., 2011; Wiley et al., 2009)

In doing these things, we enhance students' general information literacy—their knowledge and skills related to finding, using, evaluating, organizing, and presenting information acquired from diverse sources.

MATHEMATICS

Mathematics includes several subdomains (e.g., arithmetic, algebra, geometry, statistics) that use various methods for representing and solving quantitative problems. Central to all of them are the following knowledge and skills:

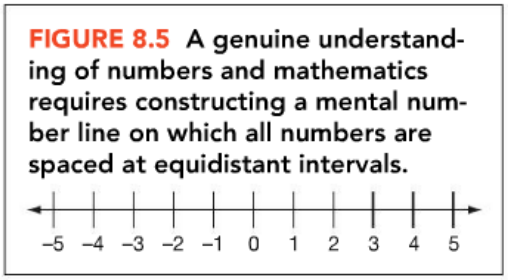


FIGURE 8.5 A genuine understanding of numbers and mathematics requires constructing a mental number line on which all numbers are spaced at equidistant intervals.

- *Understanding numbers and counting:* Obviously learners must know number words (*one, two, three . . .*), the written symbols that represent them (*1, 2, 3 . . .*), and their correct sequence. In addition, they must understand that, when counting objects, you must count each object once—and only once—until all objects have been included in the count. Learners eventually construct the mental equivalent of a *number line* on which positive whole numbers and then, later, negative whole numbers are spaced at equidistant intervals (see Figure 8.5). Learners must also become able to mentally approximate where fractions and decimals lie along this mental number line. Such understandings provide the basic foundation on which virtually all other mathematical concepts, principles, and procedures rest (Booth & Newton, 2012; Case & Okamoto, 1996; A. R. Edwards, Esmonde, & Wagner, 2011; Gallistel & Gelman, 1992; Göbel, Watson, Lervåg, & Hulme, 2014).
- *Understanding central concepts and principles:* For example, learners must master such concepts as *negative number*, *right angle*, and *variable* and such principles as "A negative times a negative equals a positive" and "The three angles of a triangle always equal 180°."
- *Mastering problem-solving procedures:* Many of these procedures are specific algorithms that, when correctly applied, always yield an accurate solution. For example, such is the case for doing long division, multiplying and dividing fractions, and solving for x in algebraic equations. But general problem-solving heuristics (e.g., identifying subgoals, drawing diagrams, rounding complex numbers up or down) often come into play as well. To be truly proficient mathematicians, learners can't simply apply such procedures in a rote, meaningless fashion; rather, they must *make sense* of the procedures so that they can use them in appropriate circumstances (Baroody, Eiland, Purpura, & Reid, 2013; Hecht & Vagi, 2010; Rittle-Johnson, Siegler, & Alibali, 2001).
- *Encoding problems appropriately:* An essential step in solving a problem is to encode it—to think of it as being a certain *kind* of problem and then represent it with relevant mathematical symbols. For example, a learner might identify one problem as requiring simple

See Chapter 7 for a more detailed discussion of algorithms and heuristics in problem solving.

addition and another as requiring solving for an unknown variable in a quadratic equation. Ideally, learners apply their mathematical knowledge and skills in encoding and solving real-world problems as well as the more traditional word problems they typically encounter in school (De Corte et al., 1996; Geary, 2006).

- *Metacognitive oversight and regulation of problem solving:* Like virtually any other complex cognitive task, successful mathematical problem solving involves metacognitive processes. The learner must set one or more goals for a problem-solving task, monitor the effectiveness of various problem-solving strategies, and carefully scrutinize final solutions to determine whether they're logical ones (M. Carr, 2010; De Corte, Op't Eynde, Depaepe, & Verschaffel, 2010; L. S. Fuchs et al., 2003).

Even as young infants, we human beings seem to have a basic ability to think in terms of quantities and relative proportions, but our systematic ways of counting, measuring, and symbolically manipulating quantities are cultural creations that not all cultural groups share (Halford & Andrews, 2006; McCrink & Wynn, 2007; Saxe & Esmonde, 2005). When children are regularly exposed to numbers and counting, many of them come to school knowing how to count—at least to 10, and often well beyond (Ginsburg, Cannon, Eisenband, & Pappas, 2006). They may also have self-constructed simple procedures for adding and subtracting small quantities of objects. For example, if they want to add three objects to a group of five objects they might begin with *five* and then count the smaller group: "Five, six, seven, eight" (Bermejo, 1996; Siegler & Jenkins, 1989). By and large, however, more sophisticated mathematical knowledge and skills come from formal instruction, especially at school.

Despite ongoing math instruction throughout the elementary and secondary grades, many students seem to have particular difficulty with mathematics as a content domain. To some degree, their difficulty may lie in their limited ability to think about proportions (e.g., decimals, ratios) and abstract concepts removed from everyday reality (e.g., *pi, infinity*) (Byrnes, 1996; Siegler et al., 2012; Tournaire & Pulos, 1985). Encoding problems mathematically can pose an additional challenge, especially if students have learned concepts and procedures only in a rote, meaningless manner (M. Carr, 2010; Clement, 1982; Geary, 2006). For example, students of all ages tend to have trouble encoding relational problems—problems in which only comparative numbers are given—and hence are often unable to solve problems such as this one:

> Laura is 3 times as old as Maria was when Laura was as old as Maria is now. In 2 years Laura will be twice as old as Maria was 2 years ago. Find their present ages. (R. E. Mayer, 1982, p. 202)

Even college students have trouble encoding and solving this problem (R. E. Mayer, 1982). (Laura is 18 and Maria is 12.)

Unfortunately, too, many elementary and secondary school students don't metacognitively reflect on what they're doing as they work on mathematical problems (M. Carr, 2010; Roditi & Steinberg, 2007). To see how metacognitively reflective *you* are when you do math problems, try the next exercise.

EXPERIENCING FIRSTHAND

BUSING THE BAND

Take a minute to solve this problem. Feel free to use a calculator if you have one handy.

> The Riverdale High School marching band is traveling to Hillside High School to perform in the half-time show at Saturday's football game. The school buses owned by the Riverdale School District can transport 32 passengers each. There are 104 students in the Riverdale band. How many buses will the band director need in order to transport the band to Hillside on Saturday?

Is your answer 3.25? If so, think about that for a moment. How is it possible to have 3.25 *buses*? The band director must actually request four buses for Saturday's game. If you fell into our trap, you're not alone. Many students develop the habit of solving word problems based on the numbers alone and overlook the realities with which they're dealing (De Corte et al., 1996).

SCIENCE

As a discipline, science has two major goals: to both describe and explain what people observe in nature. At its core is the basic assumption that the world is somewhat predictable—that the phenomena we human beings observe are various manifestations of general patterns and cause-and-effect relationships. Also central is the *scientific method*, which includes a number of more specific cognitive processes with a common element: a conscious intention to both acquire and evaluate new knowledge and explanations.

Key to scientific reasoning are the following:

- *Hypothesis formation and testing:* Scientists begin with tentative conjectures—hypotheses—about the nature of the world, its inhabitants, and the broader universe. Then, to the extent possible, they systematically test their hypotheses by separating and controlling variables that may possibly influence other variables. Good scientists look not only for evidence that confirms a particular hypothesis but also for evidence that might *disconfirm* it.
- *Careful, objective documentation of observations:* Scientists keep careful records of their observations. Ideally, they categorize and/or measure the things they observe in consistent, objective ways.
- *Construction of theories and models:* Scientific inquiry is a very constructive process. Often it involves constructing theories—organized bodies of concepts and principles intended to explain certain phenomena. It may also involve constructing models—physical or symbolic representations that show how certain entities might be interrelated parts of a larger system. For example, you've probably seen physical models of the sun and planets in our solar system, and you've undoubtedly seen graphic models of various phenomena in textbooks; Figure 8.1 in this chapter is an example.
- *Metacognitive reflection:* Good scientists think not only about the nature of things but also about the nature of *their thinking* about things. For example, they continually ask themselves whether they're being objective in their observations, whether their evidence adequately supports their hypotheses and conclusions, and where there might be holes or inconsistencies in their theories and models (Kuhn & Pearsall, 2000; M. C. Linn & Eylon, 2011; Metz, 2004; B. White, Frederiksen, & Collins, 2009).
- *Advanced epistemic beliefs about the nature of scientific knowledge:* Good scientists understand that theories and models are, at best, incomplete and potentially flawed constructions of reality and that, more generally, scientific understandings must continue to change and evolve as new evidence comes in (Kuhn, 2009; M. C. Linn, Songer, & Eylon, 1996; Wiser & Smith, 2008).
- *Conceptual change when warranted:* Good scientists continually revise their beliefs and understandings as credible new evidence and theories appear on the scene. In general, they keep open minds about the nature of phenomena and cause-and-effect relationships.

If you have previously read Chapter 2, you may have done the "Pendulum Problem" exercise, which requires separating and controlling variables.

In this pencil drawing, 9-year-old Corey portrays his science lab as one in which his teacher prescribes particular steps to follow. Ultimately, however, Corey must come to understand the true *nature* of science—that it comprises an integrated set of concepts, theories, strategies, and other cognitive tools for systematically investigating and explaining the physical, biological, and social worlds in which we live.

SOCIAL STUDIES

The term *social studies* encompasses content domains concerned with the nature of human societies and social relationships, both past and present. Our focus here will be on two domains that are especially prominent in elementary and secondary school curricula: history and geography.

THE NATURE OF HISTORICAL KNOWLEDGE AND THINKING

At its core, history is very much a socioculturally transmitted body of knowledge. Furthermore, as the opening case study illustrates, different cultural groups are likely to put their own spins on history, portraying past events in ways that are consistent with their beliefs and worldviews. For example, in the United States, European American students tend to view U.S. history as being guided by principles of freedom and democracy, whereas African American students are more likely to view it as being marked by racism and violations of basic human rights (T. Epstein, 2000; T. Epstein & Shiller, 2009). Such diverse interpretations are almost certainly the result of how various people and media in one's cultural group and larger society have described historical events (J. M. Hughes, Bigler, & Levy, 2007; Levstik, 2011; Porat, 2004; vanSledright & Limón, 2006).

A solid mastery of history, both as a body of knowledge and as an academic discipline, requires several abilities and processes:

- *Comprehending the nature of historical time:* Constructing legitimate understandings of history requires an abstract comprehension of the lengthy time span across which human events may have occurred—a time span far beyond any individual's personal experience.
- *Perspective taking:* Truly making sense of history requires recognizing that even highly influential and respected people (e.g., George Washington, Winston Churchill, Martin Luther King, Jr.) weren't perfect: They had their own foibles and fallibilities, and they made mistakes. Furthermore, historical figures lived in particular cultural and social contexts that profoundly influenced their thoughts and actions. Good historians try to put themselves in historical figures' shoes—to perceive events as those individuals might reasonably have perceived them (P. Lee & Ashby, 2001).
- *Drawing inferences from historical documents:* History textbooks often describe historical events in a matter-of-fact manner, communicating the message that "This is what happened." In reality, however, historians often don't know exactly how particular events unfolded. Instead, they construct reasonable interpretations of events after looking at a variety of historical documents that might offer conflicting accounts of what transpired (Leinhardt, Beck, & Stainton, 1994; Paxton, 1999; vanSledright & Limón, 2006).
- *Identifying possible cause-and-effect relationships among events:* Mastery of history includes not only knowledge and interpretations of events but also a sense of how some events—perhaps certain political decisions, religious movements, or economic downturns—may have directly or indirectly led to *other* events (van Drie, van Boxtel, & van der Linden, 2006).
- *Evaluating the credibility of various documents and interpretations:* Some historical documents are reasonably objective and accurate accounts of historical events and trends; government census records from past decades are an example. But many other documents—newspaper articles, personal diaries, and the like—reflect the opinions and biases of their authors. Competent historians take such biases into account when drawing their conclusions about events, but they also understand—metacognitively—that their own and others' interpretations aren't necessarily the best or only ones (Paxton, 1999; van Drie et al., 2006; vanSledright & Limón, 2006).

TAKING STUDENT DIVERSITY INTO ACCOUNT

As we teach reading and writing, we must remember that students will have had varying experiences with literacy at home. For example, the lives of some students may have been filled with storybooks and bedtime reading, whereas the lives of others may have involved more oral storytelling. Especially in the primary grades, then, we must not assume that children have mastered alphabet letters and other basics of written language. In addition, some children's families speak a language other than English at home, and other children's families speak a dialect of English quite different from the Standard English that's typically used in classrooms. Effective reading and writing instruction—and, in fact, literate activities in any content domain—takes such backgrounds into account (Janzen, 2008; Klingner & Vaughn, 2004; Serpell et al., 2005).

When teaching math and science, we must keep in mind that these two disciplines have, historically, been considered largely "male" domains. Even in this 21st century, the boys in our classes are, on average, more likely to believe they can be successful in these areas; this tends to be the case even though there are no substantial gender differences in *ability* in math and science (Herbert & Stipek, 2005; Leaper & Friedman, 2007; Wigfield, Byrnes, & Eccles, 2006). We must regularly convey the message that both content domains are important for girls as well as boys. We should also use instructional strategies that encourage males and females alike to become actively involved in talking about, applying, and mastering math and science; for instance, such strategies might involve hands-on activities and small-group discussions.

Traditionally, too, females have been given short shrift in history—as have most minority groups—in the sense that history textbooks tend to focus largely on the activities and accomplishments of European American males (Berkin, Crocco, & Winslow, 2009; Levstik, 2011). Accordingly, we may often need to supplement texts with materials that paint a more inclusive picture of our multicultural heritage. Furthermore, we must remember that students' meaning-making in social studies will, in part, be a function of the cultures in which they've been raised and the early family experiences they've had. For example, students with Japanese ancestry are likely to have a very different perspective on President Harry Truman's decision to bomb Hiroshima than students with European ancestry. And, of course, some students have had little or no experience with diverse cultural environments and far-away places. A friend of one of us authors once took students from a lower-income, inner-city Denver neighborhood on a field trip to the Rocky Mountains. Even though these children had seen the Rockies many times from downtown Denver, on seeing them up close for the first time some of them were amazed at how big they were. And a few of them were surprised to discover that the white stuff on the mountaintops was snow!

ACCOMMODATING STUDENTS WITH SPECIAL NEEDS

Many students with special needs have difficulties with reading and writing. The majority of poor readers—whether they've been identified as having a learning disability, attention-deficit hyperactivity disorder (ADHD), or some other disability—appear to have a significant deficit in phonological awareness: They have trouble hearing the individual sounds in words and connecting those sounds with letters. A few poor readers have other cognitive processing deficits; for example, they may have greater-than-average difficulty retrieving words and word meanings based on what they see on the page. In extreme forms, such reading difficulties are known as dyslexia, a disability that often has biological roots (Goswami, 2007; Shaywitz, Mody, & Shaywitz, 2006; Snowling, Gallagher, & Frith, 2003; Stanovich, 2000; Wimmer, Landerl, & Frith, 1999).